SCIENTIFIC AMERICAN

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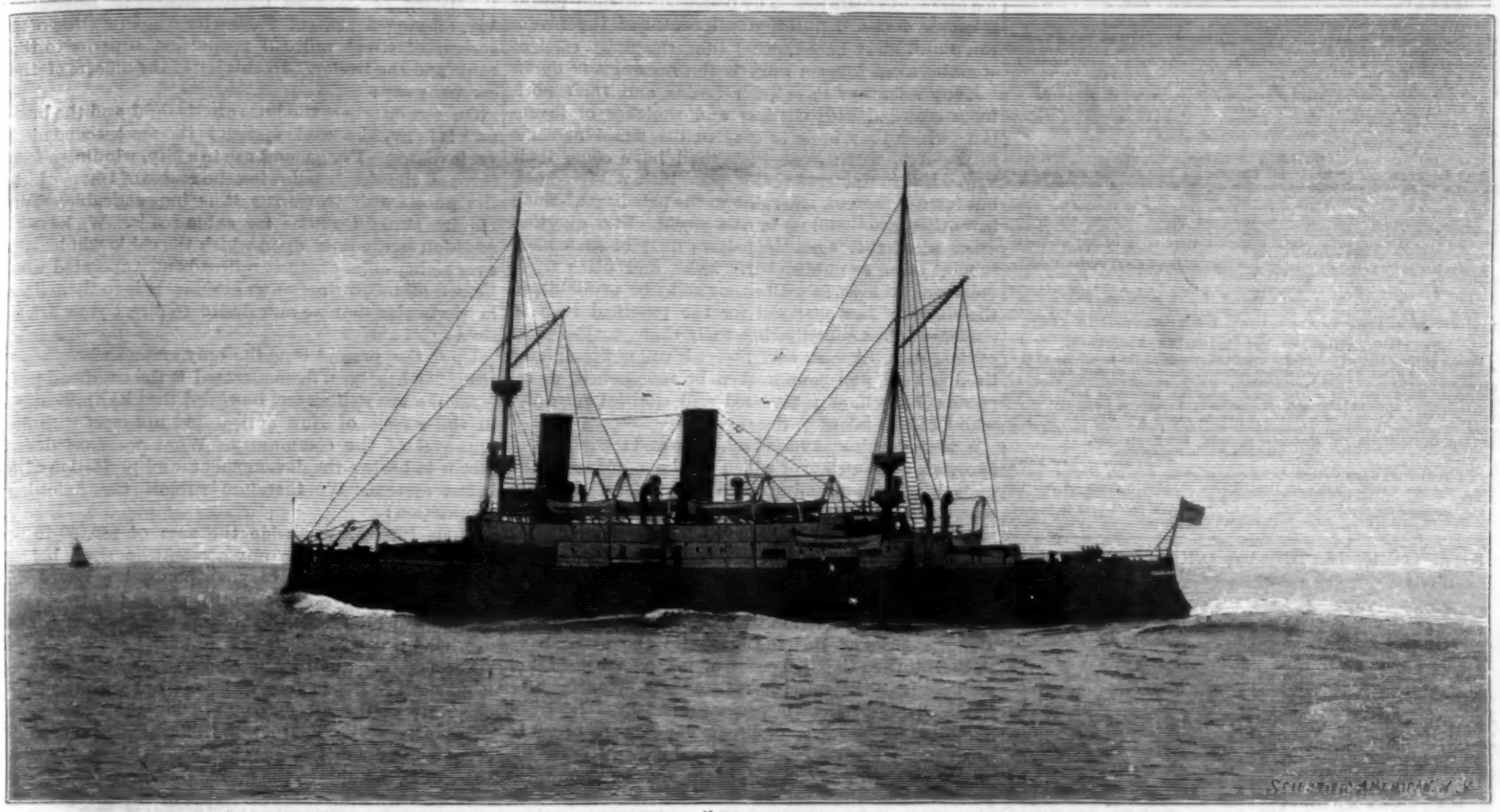
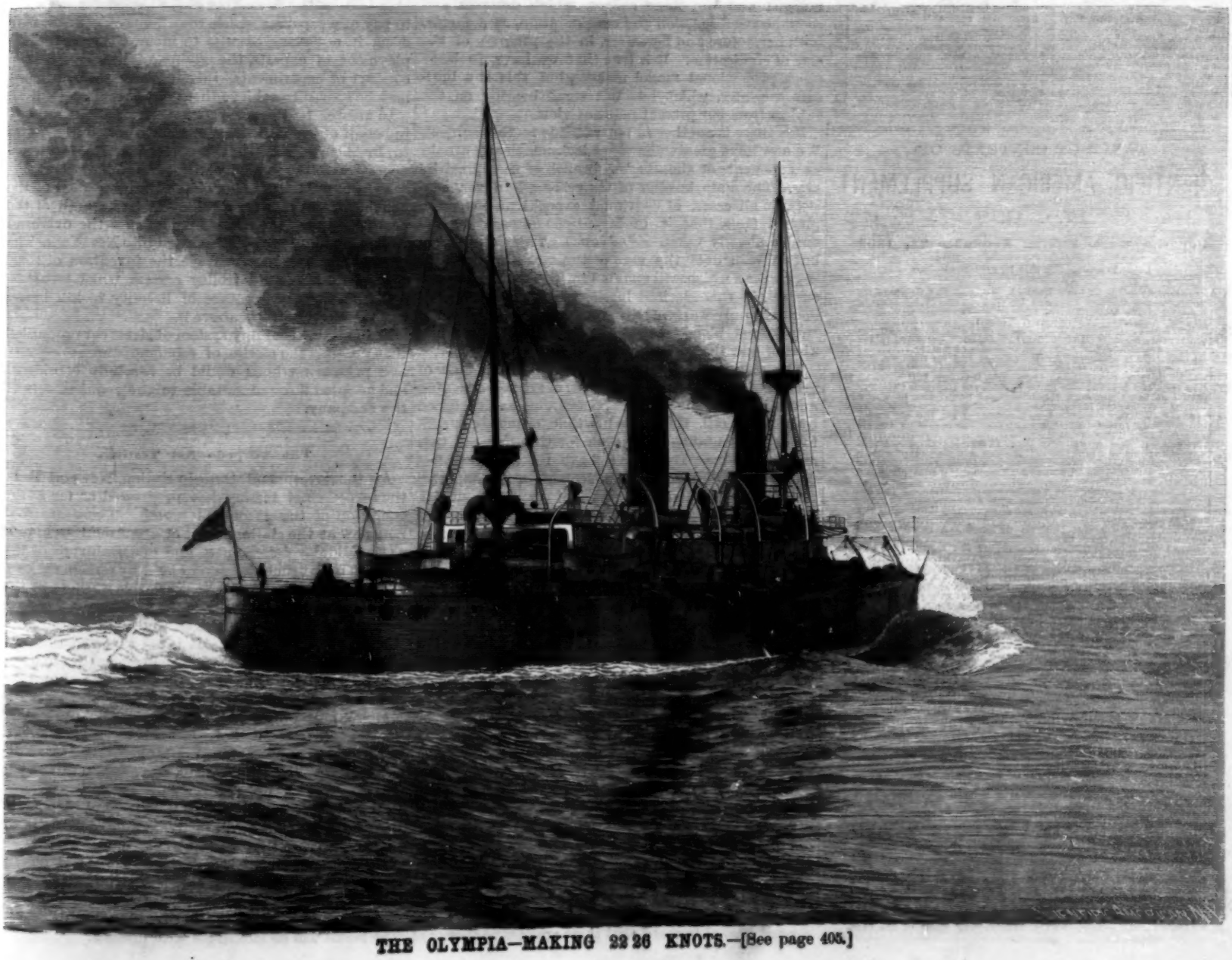


THE NEW WAR SHIP OLYMPIA—"WARMING UP" FOR THE SPEED TRIAL.



THE OLYMPIA—MAKING 22.36 KNOTS.—[See page 405.]

Scientific American.

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NEW YORK, SATURDAY, DECEMBER 23, 1893.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 938.

For the Week Ending December 23, 1893.

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THE LABORATORY AND THE WORKSHOP.

The germs of civilization are engendered in the laboratory and closet of the chemist, but are in great part cultivated and brought to fruitage in the workshop of the artisan. Every step in civilization has been at first but an idea. These ideas, conceptions, or generalizations, arise in the brain of the experimenter and thinker, but he is usually powerless, through lack of tools and manual skill, to realize his conceptions. It is not often the case that a scientist possesses both the genius to conceive original ideas and the means and skill to execute them himself, or to compensate the skill of the mechanic and artisan in working out his ideas into realities. The possession of such means is usually found to dull the enthusiasm of the inventor, and it must be admitted that the most efficient stimulus to such brain work is the *res angusta domi*.

Many scientists have their brains and their portfolios crowded with outlines and sketches of inventions which they hope to give to the world at some future day, when *good luck* shall have come their way. But in numerous cases, good luck never comes, but instead thereof, the rider on the pale horse. Such inventions are then lost to the world. The question arises whether it is not the solemn duty of such men, in most cases, to publish their ideas, and place them on record, at least in such forms as to be available, in the shape of raw material for the practical man to elaborate, thus contributing their share to the weal of their race. A man who does this will not then have lived in vain, and cannot then be reproached, or reproach himself, as a "wicked and slothful servant," who "hid his talent in the earth."

A man of wide and varied scientific and technological experience—of a class of which we have many—often finds his brain teeming with new ideas. He can scarcely consider an industrial subject, when the mood is on him, without finding his mind crowded with novel combinations. These it is no irksome task for him to think out and elaborate, but a positive pleasure. Such pleasure is akin to that which actuates the poet and the artist in working out their inventions and conceptions. But the poet and the artist have the advantage that a penful of ink or a brushful of pigment is all they need to realize their inventions for public behoof. Here is where the scientist is weak, and often at the mercy of circumstances. In order to progress, he must go to the workshop and open his mind to the artisan and obtain the vicarious aid of his tools and his skill. We have then a very important and essential correlation between the scientific technologist and the wage earner, which deserves and should have discussion and consideration, as a factor, both heretofore and hereafter, in the progress of the arts of civilization. It is true that we have, in large cities, professional model makers, but this is a business specialty, which has but small bearing on the subject from our present point of view.

But there is another important side to this subject. We now have great numbers of technological journals, as exponents of almost every branch of the industrial arts. The main burden of their song, however, consists, in all cases, of continual expositions of accomplished facts, that is, of inventions already made—strides already taken in advance. This is all well; but in vain does the man of the workshop look for suggestions which will enable him to take part in the contest, in this glorious intellectual strife to benefit man, the only warfare that should be tolerated on the "dark and bloody ground" of our planet, the only kind of war that does not "make the angels weep."

The wage earner may be, and often is, a man of great native brain power, and even of extensive reading and high intelligence. But his energies are absorbed by his daily toil. He seldom has time, or means, or skill for experimental work, or even for thinking out new generalizations. He needs to have these more or less prepared for him, and then he can often get opportunities to realize them in the form of a working model, or piece of apparatus; say, a new oil lamp or gas burner or glow lamp, a new metallic alloy, or a new use or application of some one of the great multitude of materials and agents that have been continually coming before the world and growing cheaper during this century.

Occasionally complaints come from one of these men, that the field of invention seems to have narrowed or become exhausted, and asking what there is left to which they can bend their minds. This is due merely to the lack of spare time and energy to think and study. The conceiving of new inventions *may* be partly a matter of genius or intuition, but it *is* a faculty which requires knowledge and application to master, and practice to acquire skill therein. The field, instead of narrowing, is now rapidly broadening, and in an increasing ratio. The new metals and chemical materials continually coming forward and cheapening must necessarily insure this result. Future articles of this series will set this forth further. As one example, fine electrolytic copper is now but half what it cost a few years ago, and the sources and methods of production have been so greatly multiplied, improved and cheapened that there appears no chance of any important future rise in price. Hence copper and its numerous valuable alloys can now be applied to new uses, for which it has hitherto been too costly. Numerous other examples will be cited hereafter.

It is now proposed that this journal shall do more than hitherto to remedy the deficiency we have pointed out, and to indicate paths of promise to inventors, so far as human science is allowed to determine these.

A Prize of Fifty Thousand Dollars Offered for Improved Method of Propelling Street Cars.

The Metropolitan Traction Company sent a letter to the Board of Railroad Commissioners in November last, offering a prize of $50,000 for the invention of a system of street railroad propulsion superior to the cable and the trolley. In this letter the officers of the company say:

On streets where the lines are straight and the business is heavy the cable system is the most economical yet invented. For general use in a city, winding about through the streets following the routes of travel which the public wish to pursue, it is impracticable. You require straight routes for cable roads. We have in addition to the lines upon which the cable will be laid over eighty miles of street railroads now operated with horses, all below the Central Park. It is to these lines in particular that we now desire to direct your attention.

Up to the present time the only system whose practicability has been demonstrated is the overhead trolley. We are well aware, however, that its application in the streets of New York would not meet with the approval of the community. What we most desire now is to hasten the development and perfection of a better system. We therefore submit the following proposition:

First—We will set aside the sum of $50,000 to be awarded as a prize to any person who shall, before March 1, 1894, submit to your honorable Board an actual working system of motive power for street railway cars demonstrated to be superior or equal to the overhead trolley.

Second—The qualities necessary to meet this requirement shall be left to your decision; but with the present state of the art, a system to win the award must necessarily approximate the trolley as a standard of economy in operation, but should be without the features objectionable to the public that are in it.

Third—We shall exact no rights in the invention in return for the $50,000, and shall have nothing whatever to do with the making of the award further than to pay any expenses which your honorable Board may deem it necessary or wise to incur, either in the employment of experts, the giving of hearings, or the conduct of experiments—this in order that no effort may be spared to achieve the desired result.

In answer to this proposition, Mr. S. H. Beardsley, in behalf of the Railroad Commissioners, sent a letter to President John D. Crimmins, undertaking to cooperate with the company with certain limitations.

Mr. John D. Crimmins states that the offer of the company was made for the best interests both of the company and of the city. He was sure the overhead trolley would never be introduced into New York. The general idea was to encourage the invention of some sort of underground trolley system which would be free from the disadvantage of liability to kill horses and men in the streets above it.

We presume that any system of street car propulsion that presents the merits of economy and superiority over present methods would be carefully considered and adopted if found suitable to the requirements of the company.

The Torpedo Net Testing.

At the government torpedo station, Newport R. I., the torpedo net testing has progressed as far as the condition of the season will permit. There are four nets now at the station, three of the American known as the Midgley defense nets, and one Bullivant of the English make, such as are now used by foreign nations. Projectiles are used to test the relative strength of the nets and show their condition when pierced. The projectiles are 27 ft. 4 in. in length, and 16 in. in diameter, weighing about 1,600 lb. It is not expected that any net will stand a projectile which will pierce the strongest ironclad afloat. Your correspondent was shown the different nets that have been pierced, which are the Midgley nets only, and in each one the upright or woven wire strands only have been severed. The horizontal strands remained unbroken. It is absolutely necessary that they be non-corrosive in salt water, and as thin and light as possible. Wire heavily galvanized with zinc will resist salt water, but the ends of the wires where cut are not galvanized and will corrode in the water, so that they are coated over with a varnish, but sometimes this varnish is rubbed off by rough handling. The commander in charge is desirous of obtaining a metallic mixture of the greatest possible strength and absolutely non corrosive in salt water. The result will be looked for with interest.

The Electric Light Column.

On the evening of the 19th inst., says the Philadelphia *Ledger*, the huge wooden casing in front of Wanamaker's was taken down, and there stood revealed a handsome column of incandescent bulbs, with broad spiral stripes, each of a different color, white, blue, purple, orange, green, yellow, and crimson predominating. The column is about 25 feet high, and from it extend four long arms lined with rows of glass bulbs of different colors, two of the arms in the side aisles terminating in 25 bulbs each, and two in revolving balls of 266 bulbs each, at either end of the Chestnut Street facade, all handsomely colored. At intervals of a few seconds each stripe flashes with light, one brilliant color swiftly following another until the top of the column is reached, when the varying light is diffused along each of the arms until the two large bulbs are reached, where the flashing continues until all the colors are shown. Meanwhile the two large balls are kept revolving, and flash continuously with varying lights and colors. The whole affair, whose effect is very pretty, is ingeniously managed by a switchboard in the basement under the column, where a large cylinder, somewhat like that of a music box, is kept revolving by the dynamos of the establishment, the teeth in the cylinder closing and cutting off the circuit as contact is made with or withdrawn from the rows of separate conductors on the sides of the switchboard. As the lights change from one color to another they go out completely, leaving no lingering glow in the carbons to spoil the effect, as would be the case were it not that this has been guarded against by a current of air being ingeniously injected automatically by the machine.

The arrangement was a part of the famous electrical display at the World's Fair, where it elicited the admiration of thousands of visitors.

Opening of the Manchester Ship Canal.

The necessities of modern commerce have produced great ocean-going steamships, "the shuttles of commerce," and also the huge ship canals, which facilitate the movements of these large vessels and lessen the cost of transportation. We have from time to time described the progress of one of the great engineering feats of the day—the Manchester ship canal; and now we are glad to state that the canal is completed, and that the official opening took place December 7. The public opening will not take place until New Year's day, when a procession of vessels up the canal will take place, headed by the bark Wilhemine from Parrsboro, Nova Scotia. This vessel reached Garston November 27, and is now waiting for the opening of the canal to public traffic. It is laden with lumber. The company will pay £100 for the delay it incurs in waiting for the public opening of the canal. The captain of the Wilhemine will receive a handsome gold watch as a memento of the occasion.

The Midland counties of England are large consumers of raw material, and much time and expense will be saved by using the new canal. The Manchester canal will probably prove as valuable to Manchester as the North Sea canal has been to Amsterdam or the Cronstadt canal is to St. Petersburg. It is a curious fact that Peter the Great's original plan when he founded St. Petersburg was to make the new capital a port for sea-going vessels by means of a ship canal. The new Manchester canal compares favorably with other ship canals, except as regards length. This great undertaking cost about $75,000,000. The work has been illustrated and described in the SCIENTIFIC AMERICAN.

The Sea Trial of the New York.

The cruiser New York has just completed a series of general tests. According to law, the New York could not be legally accepted by the government, or the contractors receive the $50,000 reserved from the previous payments for building her, until a final test was made. The object of the test was to determine, by a forty-eight hours' run, her sea-going qualities and her structural strength. The rough December sea was admirably adapted to test the endurance of the new boat and the results considered as a whole are satisfactory, although some defects were made apparent.

The men were sent to their allotted stations on Monday, December 11, and every part of the vessel was subjected to a rigid inspection, every engine was minutely examined and run at varying rates of speed; the guns were fired, but not a rivet started and every bolt was in place when the three hours' firing test ceased. The turret-turning machinery was defective, and will be altered. The amidships magazine was found to be too near the fire room, as when the vessel is under steam the temperature reaches 120° in this compartment. Some of the ammunition hoists were inadequate to supply the guns rapidly enough. The arrangement of the sick bay in the bow is a serious defect, as the vibration is felt most here and the roar of the waves when at sea is deafening. The sick bay was flooded during the trip, water coming in through the torpedo tube. This fault of location is not to be laid at the door of the contractors.

Digestibility of Farinaceous Foods.

These enter so largely into the dietary of all invalids, that nurses and others should know that they are not all equally able to be digested. Experiments have lately been made on the different starchy foods, as to the rapidity with which they digest when treated by malt and pancreatic preparations. One gramme of each of the following starches and meals was boiled and made up to 100 c. c. with water. In each case the effect of 1 c. c. of pancreatic essence on the mucilage at 100 deg. F. was noted, a dilute solution of iodine, placed in drops on a white slab, being used as an indicator:

Indian Corn.—After digesting three hours with the pancreatic essence still gave a distinct blue with the indicator. Twenty hours' digestion appeared to have no further effect.

Wheat.—Distinct blue after two hours' digestion.

Rice.—Distinct blue after two hours' digestion.

Tapioca.—After half an hour's digestion gave only a faint green with the indicator.

Arrowroot.—Ceased to give a blue in ten minutes.

Potato.—Ceased to give a blue in ten minutes.

Oatmeal.—Gave a scarcely visible blue after digesting eighty minutes.

Wheat Flour.—After two hours' digestion gave a very faint blue.

Potato Flour (2 grammes).—Ceased to give blue in ten minutes.

Thinking that prolonged boiling might have some effect on the convertibility of starch, some experiments were instituted to test the point. Solutions of arrowroot and corn starches were brought to the boiling point in one case and in the other boiled for ten minutes. The time required for digestion was, in each case, the same, *i. e.*, the arrowroot ceased to give a blue in ten minutes and the corn still gave a blue after three hours' digestion. These experiments were repeated with malt extract and point to the following conclusions: Arrowroot and potato starches are the most readily converted into sugar by the amylolytic ferments. They are, therefore, the most suitable for testing malt and pancreatic preparations. Arrowroot and potato starches are the best for weak digestions. Chemically there seems to be no difference in digestibility between low-priced arrowroots, nor between the latter and potato starch. Root starches are more digestible than seed starches. So long as starch granules are burst, further (limited) boiling does not render them more digestible. In further experiments it was found that the addition of either acid or alkali to the pancreatic juice retarded the conversion of starch, but with saliva in the absence of either the conversion took place in four minutes.—*Pop. Med. News.*

Effect of Light on Oysters.

At a recent meeting of the Academy of Natural Sciences, Philadelphia, Professor John A. Ryder spoke of the effect on oysters of exposure to light. He referred to recent observations of Dr. Scheidt on the pigmentation of these mollusks under abnormal conditions. The right valve of the shell having been removed, the oysters were kept in a trough of running salt water. In fourteen days they showed a pronounced blackening of the entire right mantle, where normally there is no pigment, and this was again bleached when excluded from the light. Other specimens which were guarded from the direct action of the light remained uncolored, thus demonstrating that light is the active agent in producing the deposit of pigment granules. Blue glass was found to stimulate coloring, while red glass had the opposite effect.

Professor Benjamin Sharp remarked that a common species of flounder, Aclinus lineatus, commonly called the hog choker, has the underside almost if not quite as strongly colored as the upper side, thus differing materially from the other species of this group of fishes. Correspondingly it was found that its habits were so modified that the lower part of the fish was frequently so exposed as to be acted on by the light and not kept in contact with the rocks as in allied forms.

Dyeing Leather, Feathers and Other Animal Fibers.

F. Obermeyer, of Vienna, has a new process of dyeing animal fibers, which is said to be peculiarly applicable to feathers, leather, and horn. It depends on the fact, first, we believe, pointed out by Knecht, that the animal fibers resemble amido compounds in their constitution, and are therefore capable of becoming diazotized. This is done by subjecting them to the action of weak solutions of sodium nitrite acidified with hydrochloric acid for twelve to twenty-four hours, under conditions which exclude light. The diazotized fibers are then treated with either—first, neutral aqueous solutions of phenols at 80° C.; second, cold ammoniacal solutions of alkaline phenolates without excess of free alkali; third, neutral solutions of amines; fourth, acetic acid solutions of amines. In this method of dyeing and with such solutions the fibers remain quite uninjured. Red, yellow, and brown shades can thus be dyed. Those produced from amido bodies can be further diazotized and redeveloped into new shades, while by treatment with various metallic salts, copper chloride, ferric chloride, zinc acetate, potassium, etc., the shades are modified, being made darker and faster. All the shades are full and brilliant, and on the whole fast to soap.

Soap Bubble Solution.

According to a communication recently made to the Academy of Sciences, the following solution affords very thin and permanent bubbles:

Yellow resin	10 grammes.
Carbonate of potash	10 "
Water	100 c. c.

Boil until completely dissolved, and before use dilute the solution with four times its volume of water. It is somewhat difficult to float soap bubbles upon carbon dioxide, because if you managed, after a score of trials, to free your bubble from the pipe on which you blew it, the bubble usually bursts the moment it touches your heavy gas. You must remove every trace of hydrochloric acid, which is carried over with the gas, by washing, the presence of this acid being fatal to the life of a soap bubble.

Canal Cutting and Dredging on the Sacramento.

The progress of work by the new canal digging machine on Grand Island and of the dredger for strengthening the levees are thus described by the *Record-Union:* The machine built to cut the drainage canal inside the island is a one-yard Marion Steam Shovel Company's ditch dredger. The machinery was placed upon a hull 22 feet by 70 and cuts a canal 23 feet wide. This machine was started to work September 18, and excavated during the remainder of that month 16,100 yards, requiring of course some few days for the thorough adjustment of the parts. During the month of November it excavated 62,770 yards, or 2,414 yards for each working day in the month, or 115 yards for each working hour.

The material was deposited on both sides of the cut, and the month's work was a uniform canal 12,413 feet long for 2½ miles, 23 feet wide and a little over an average of 6 feet deep. The only delays were occasioned by fog on the morning watch, which on six or seven mornings occasioned a delay of three or four hours.

This machine is in charge of Allen Adams and is giving the landowners first-rate satisfaction.

The dredger Grand Island, built for the river levees, is a clam shell, with a hull 40 by 80 feet and with a boom 105 feet long. This machine is handling a bucket weighing 8,000 pounds, with wire ropes in place of chains. It was started to work on the 30th of October and for 22 hours per day is delivering, as nearly as may be, one bucket per minute, averaging in the material it is working in (fine river sand) two cubic yards to the bucket. This material, from the point of excavation to the point of delivery, is being moved 150 feet.

This dredger is building a roadway outside of the present levee 16 feet wide, and at the same time furnishing material to put a two-foot crown on the levee. It has already made one mile of this work, and it is expected to progress at the rate of about a mile in 11 days. It is in charge of J. Hyde, and with a few more days' breaking-in of the machine and crew will be a very efficient machine.

The machinery is all completed by Byron Jackson for the additional pumping plant to be installed at Ryde, and this plant will have a capacity of 30,000 gallons per minute, with compound engines of the newest type, and will, it is believed, with the large plant already in, give complete control of the rain and sipage waters.

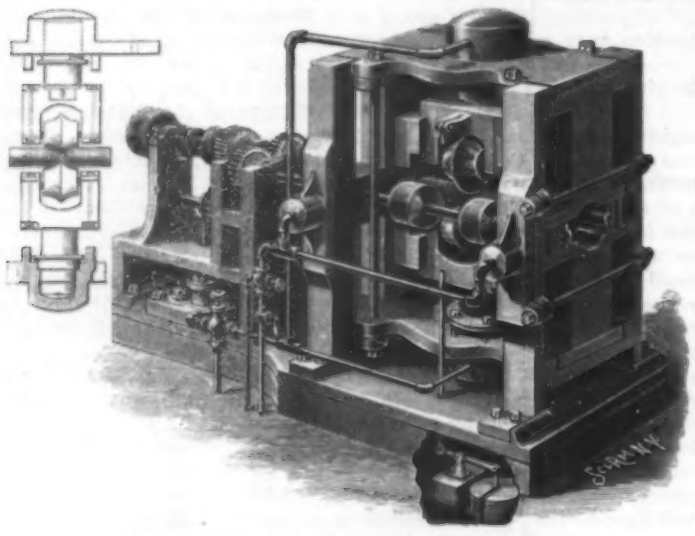
The Plumber's Hat.

Has a plumber a right to wear his cap in one's house? This was the point submitted to the Highgate justices by an ex-fellow of Balliol. The plumber and his son came to the ex-fellow's house to clear away a stoppage in the bath. Arrived at the scene of operations they kept on their caps, as is the use of British workmen. The householder lectured the parent plumber on the bad example he was setting his son in not teaching him to take his cap off in a gentleman's house. The parent replied by setting up the custom of the trade to work covered. The plea was overruled, and the father plumber's cap thrown out of the window by the indignant ex-fellow. Then the parties aggrieved adjourned to the open air (it was drizzling), and went—the plumber capless and the ex-fellow carrying the plumber's cap—to seek counsel and advice of the nearest policeman, who referred them to the justices. The ex-fellow says that he was on the way called by the plumber "a thick-headed old fogy." Yet the justices fined him 10*s.* for his manner of giving a lesson in manners, and gave him no redress for this very unacademical language.

FRANCE will soon adopt an interesting innovation in the postal card system. The cards will be issued in the form of checkbooks, with stubs. The sender of the postal card can make memoranda of its contents on the stub, and can have this stamped at the post-office before the card is detached, so that a verified record of the correspondence can be kept.

A MACHINE FOR FORMING PROJECTILES.

This is a strong and simple machine designed to form projectiles two at a time, the machine being perfectly under the control of the operator, and rolling the projectiles so accurately that they are well adapted for the best marksmanship. The improvement has been patented by Mr. John S. Griffin, Roslyn, Washington. The small figure shows parts in section, with the forming rolls and the hydraulic cylinders which move the rolls vertically. The end standards of the machine have on their inner sides guide ribs which support guide blocks for the ingot and also serve as guides for the piston heads, which move alternately toward and away from each other as the ingot is rolled. The forming rolls align vertically and have convex faces, the face of each roll having a sharp edge extending annularly around it in the center. The piston heads are secured to pistons operated like the usual hydraulic pistons, the cylinders being supplied with water from a common form of force pump. The upper piston head has on

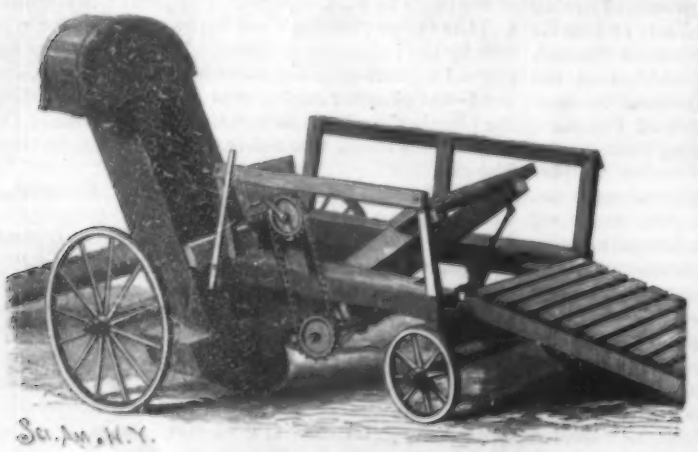


GRIFFIN'S MACHINE FOR FORMING PROJECTILES.

opposite sides lugs in which are pivoted depending rods which extend downward to the base of the machine and are pivoted to levers, each fulcrumed on a shaft, and connected with counterbalanced weights to return the piston and piston head when the water has been withdrawn from the upper cylinder. The cylindrical ingot is prepared for the machine by slightly reducing it in the center, preventing too much metal from being crowded toward the shoulders of the projectiles. The metal is treated hot, the forming rolls being forced against the ingot from above and below, the ingot being at the same time revolved and firmly held in place by rollers arranged in pairs on opposite sides of the central portion of the machine. These rollers approach the ingot horizontally, the boxes of one of the shafts being coupled directly to pistons which move in horizontal hydraulic cylinders. An independent water supply is provided for the sets of cylinders, so that the forming rolls and the driving rollers may be independently moved when desired. It is designed by this improved machine to effect a great reduction in the cost of twelve-inch and other projectiles and all varieties of mortar shells.

A PORTABLE GRAIN DUMP.

A machine designed to facilitate the handling of corn and all kinds of grain, effecting a great saving in labor, is shown in the accompanying illustration, and has been patented by Mr. Charles L. Young, of Imogene, Iowa. The machine may be driven direct to the car side, and used to load the car ready for shipment. The bed of the machine is mounted on a forward axle and two rear axles of angular construction, and near the rear end of the bed is a pit, within which a hopper is secured. The lower end of the hopper is open and adapted to receive grain or other material dumped and deliver it to the ground or to an elevator or conveyor. The elevating mechanism may be driven by a beveled gear by turning a crank at one side of the machine. In front of the cover of the hopper are longitudinal openings in the bed, and in each of these openings is a balance or dumping beam, the beams being connected by a cross bar and the operation of a lever locking the beams in fixed position. Beneath the central portion of the bed is a shaft carrying a sprocket wheel connected by a chain with a second sprocket wheel journaled in a standard, and by rotating the upper sprocket wheel by means of its crank the lower shaft is rotated to tip the balance or dumping beams from a horizontal to an inclined position or *vice versa*. Platforms are removably connected with the ends of the bed, so that a team may be driven up one platform to the bed and from the bed down the other platform to the ground. A loaded wagon is thus driven up one platform and over the bed until its wheels rest upon the dumping or balance beams, when the locking bar is disengaged and the crank rotated to carry the beams to an inclined position; the load will then be dumped into the hopper or any receptacle placed to receive it, or will be conveyed from the hopper to the elevator.



YOUNG'S PORTABLE GRAIN DUMP.

Soldering Aluminum.

By means of the alloys mentioned below, aluminum or other metals, such as iron, tin plate, zinc, copper, brass, nickel, it is said, can be rapidly and easily soldered, either with the brazing iron or blowpipe. Aluminum can also be soldered to any of the above metals; the material is cheaper than any hitherto employed, gives a solid joint, and does not injure the metal by oxidation or otherwise: (1) Unalloyed pure tin, melting point 250°; (2) tin 1,000, lead 50, melting point 280° to 300°; (3) tin 1,000, zinc 50, melting point 280° to 330°; (4) tin 1,000, copper 10 to 15, melting point 350° to 450°; (5) tin 1,000, nickel 10 to 15, melting point 350° to 450°; (6) tin 900, copper 100, bismuth 2 to 3, melting point 350° to 450°. The first three do not color aluminum, and can be used for ornamental and artistic objects. Four and five are yellowish in color, but have the advantage of higher melting point and greater strength and hardness, and suggest the possibility of using aluminum for various articles and purposes for which hammered, coated or enameled iron, tin plate, copper, zinc, lead, etc., are now used. The *Journal* of the Society of Chemical Industry says the last alloy can be made to assume any tint of yellow by varying the proportion of copper, and is, therefore, suitable for soldering aluminum bronzes; the proportion of bismuth is adjusted so as to keep the melting point suitable for the use of the brazing iron.

For Tired Feet.

Walking heats the feet, standing causes them to swell, and both are tiresome and exhaustive when prolonged. There are various kinds of foot baths; authorities differ as to their value. Hot water enlarges the feet by drawing the blood to them; when used they should be rubbed or exercised before attempting to put on a tight boot. Mustard and hot water in foot bath will sidetrack a fever if taken in time, cure a nervous headache and induce sleep. Bunions and corns and callousness are nature's protection against bad shoe leather. Two hot foot baths a week and a little pedicuring will remove the cause of much discomfort.

A warm bath with an ounce of sea salt is almost as restful as a nap. Paddle in the water until it cools, dry with a rough towel, put on fresh stockings, have a change of shoes, and the woman who was "ready to drop" will have a very good understanding in ten minutes. The quickest relief from fatigue is to plunge the foot in ice cold water and keep it immersed until there is a sensation of warmth. Another tonic for the sole is a handful of alcohol. This is a sure way of drying the feet after being out in the storm. Spirit baths are used by professional dancers, acrobats, and pedestrians to keep the feet in condition.—*Pacific Record of Medicine.*

THE *Electrical Review* thinks that some simpler device for controlling the brakes and current on trolley cars is required. As it is now, the mechanism is too complicated, there are too many motions to be made by the men in charge; for it is only by the quickest movements that they are enabled to control their cars in a short time.

AN IMPROVED POST OFFICE BOX.

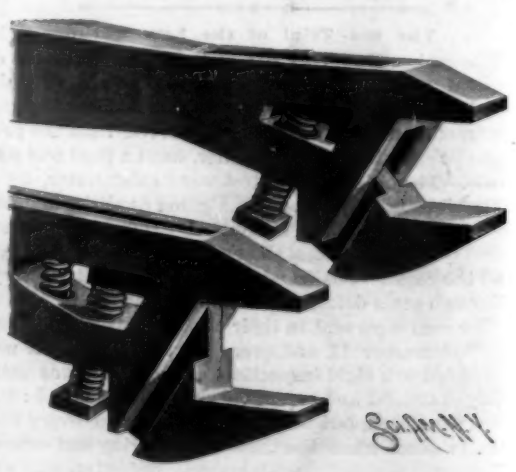
The illustration represents attachments for post office boxes arranged in tiers, whereby the proprietor of a box may readily see when it contains any mail matter, but no one can look into the box. The improvement has been patented by Mr. Henry A. Sheldon, Arcadia, R. I. The swinging doors at the front ends of the boxes have each a horizontal slot in which appears the word "full" or "empty," carried by a sign on a plate which moves vertically between the door and inside guide bars. The latter are curved over the

SHELDON'S POST OFFICE BOX.

top of the sign, limiting its movement, and the sign is carried by swinging rods or levers fulcrumed in hangers suspended on a cross rod extending transversely through the box near the center and top. A platform in the lower rear portion of the box is suspended from the rear ends of the rods or levers by means of hangers, and the sign is slightly heavier than the platform, so that when there is nothing on the platform the sign will drop to display the word "empty," but when any mail matter is placed in the box the platform is tilted and the sign "full" is exposed in the slot in the door. The improvement may be readily applied to any ordinary post office letter box, the sign being always automatically operated.

AN IMPROVED WRENCH.

The illustration represents a very simple and durable wrench adapted for use wherever an ordinary monkey wrench may be employed, as well as in some places where the latter tool could not be used. It has been patented by Mr. Edward P. Jones, No. 18 Armat Street, Germantown, Philadelphia, Pa. In one view the jaws are constructed to take a polygonal nut and in the other to receive a square nut. The handle of the wrench is formed integral with its upper outer end and jaw, and the lower forward portion of the handle has a downwardly extending lip, the lip being provided with a more or less angular chamber. The lower jaw is vertically adjusted by means of a screw passed through a threaded aperture in the under surface of the handle back of the lip, the upper edge of the screw engaging with the under face of the head section of the lower jaw shank. When the jaws are shaped to receive a polygonal nut, the handle is placed at an angle of fifteen degrees to the jaw, and where the jaws are



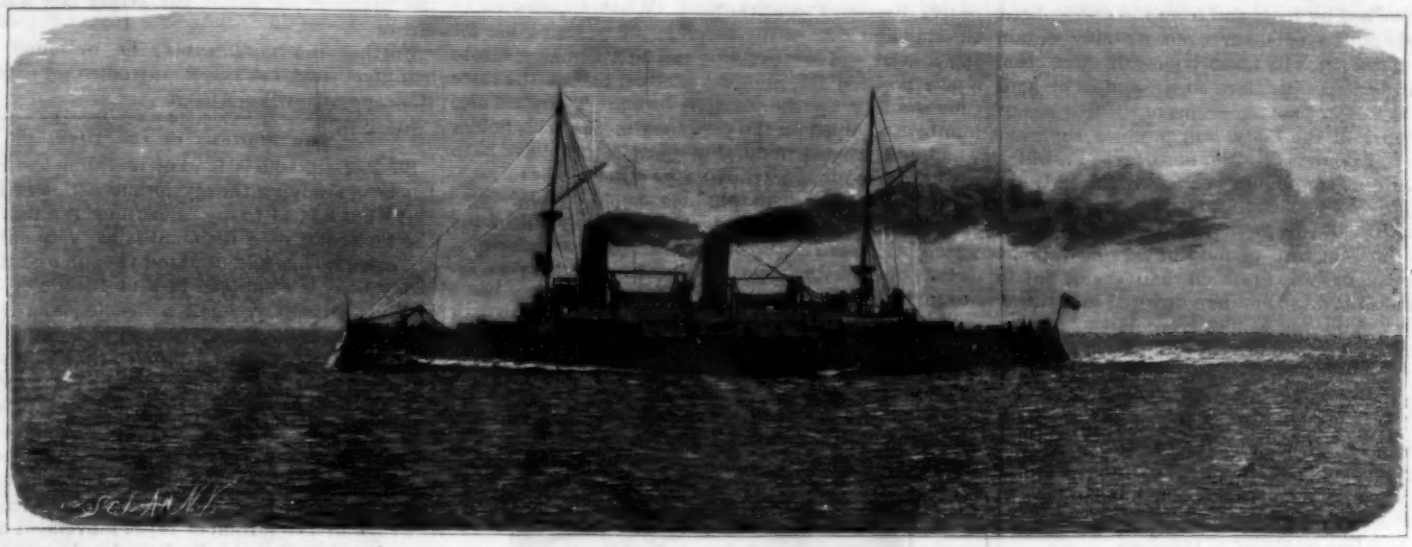
JONES' WRENCH.

formed to receive a square nut, the handle is placed at at angle of about twenty-two and a half degrees to the jaws, this relation between the jaws and handle having been found in practice to be most advantageous for manipulating the wrench in the smallest possible space.

THE first tunnel for commercial purposes was executed by M. Riguet, in the reign of Louis XIV., at Bezieres, France.

THE NEW AMERICAN WAR SHIP OLYMPIA.

The cruiser Olympia, built at the Union Iron Works, San Francisco, Cal., has recently been completed, and in her trial trips has proved herself one of the noblest and fastest ships in the navy. The speed, as contracted for, was to be 20 knots. Her construction was authorized by the act of September 7, 1888. This act called for a cruiser of about 5,300 tons displacement. The speed of 20 knots had then been attained by the Spanish



THE NEW WAR SHIP OLYMPIA RUNNING AT 22 KNOTS.

ship Reina Regente, the fastest war ship then afloat, a vessel which will be remembered by many of our readers as having participated in the naval parade at New York last spring. Bids for the Olympia were called for on April 10, 1890, and two months later were opened and the contract awarded to the Union Iron Works, of San Francisco, which proposed to construct the vessel on its own plans for $1,760,000, or on the department's plans for $1,796,000. The limit set by the act of Congress was $1,800,000. The contract called for the completion of the vessel on April 1, 1893. A speed premium was offered.

To secure more space in the fire room the contractors, at their own expense, lengthened the hull 10 feet. The ship is 340 feet long on the load line, 53 feet beam, 33½ feet deep, and draws 21½ feet of water. Her displacement is between 5,500 and 5,600 tons. She has three complete decks; one of which is a protective deck, and is virtually a substitute for side armor, none of which she carries. This protective deck joins the hull beneath the water line at an angle of 30°. It is 4¾ inches thick on the slopes amidships. On the forward and aft slopes it is 3 inches thick. Its flat central portion is 2 inches thick. Above the protective deck a belt of water-excluding material is carried up the sides, 2¾ inches thick and rising 4 feet above the water line. She has a cast steel ram in the bow. Her two masts are provided with military tops for Gatling guns and search lights.

The main battery consists of four 8 inch and ten 5 inch breech-loading rifles. The 8 inch guns are mounted on the main deck, forward and aft, in elevated steel barbettes, 4 inches thick, covered with conical roofs. These are about 10 feet above the deck, giving the guns a very extended training capacity. The ammunition tube leading to the barbettes is of steel and is 3 inches thick. The 5 inch guns are mounted in the central superstructure. They are protected by segmental shields, also 4 inches thick. Four can fire directly ahead, four astern, or five can fire abeam on either side. The secondary battery contains fourteen 6 pounder rapid-firing guns, protected by 2 inch shields, six 1 pounder rapid-firing guns, and four Gatlings. There are six torpedo tubes, one in the bow, one in the stern, and two on each side. The tubes are of the Howell type.

The ship is driven by twin screws, actuated by triple expansion engines of 13,500 horse power, calculated at 160 pounds pressure and 128 revolutions per minute. The high pressure, intermediate, and low pressure cylinders are of 42 inches, 59 inches, and 92 inches diameter respectively, and of 42 inches stroke. The main valves are of the piston type, worked by the Stevenson link motion. Bronze bed plates are used throughout. The main journals are lined with Parson's white metal put in under a hydraulic pressure of 15 tons per square inch. There are six boilers: four double-enders, 15 feet 3 inches diameter and 21 feet 3 inches long. Two are single-enders, of the same diameter and 11 feet long. All can be worked under forced draught on the air-tight fire room system. The total grate surface is 824 square feet, and the heating surface is 28,300 feet. She is fitted out as a flag ship, having admiral's quarters, and is designed to carry a crew of 466 men.

Official trials were made November 25, but not completed. The trials are to be soon resumed. On the first trials a maximum speed of 22·3 knots was attained and an average of 22·15 knots, reduced by tidal corrections to 21·85 knots.

We are indebted to Mr. P. E. Law, of Santa Barbara, Cal., for the photographs from which our engravings were prepared. These were instantaneous photographs taken from the deck of the U. S. S. Patterson.

THE STATE DAM, MOHAWK RIVER, AT COHOES, N. Y.

This work is known as the "State dam," in contradistinction from the dam of the Cohoes Water Power Company, located about a mile above the falls, and by its means and a bridge the boats on the Champlain or Northern Canal are enabled to cross the river, which at this point is 1,700 feet wide. Several previous dams built here have been carried away.

Fig. 1 shows the method of constructing the apron. Strong ribs grooved on their inner edges are secured by braces to the masonry of the dam and then sheets of iron are introduced between the ribs, as shown in our engraving. The lower half of the apron is first built and the space between the iron plates and masonry filled in solid with concrete cement, then the upper half is made in the same manner and the cement carried up behind the iron plates to the top.

The top of the dam is finished, as seen in Fig. 2, by laying strong girders, which are firmly anchored to the masonry coping, and upon the girders iron plates are attached, the interstices between the girders and covering plates being solidly filled with hydraulic cement or concrete. The whole work is of the strongest and most substantial nature.

The dam is built by Messrs. Cunningham & Morety, under contract with the State, the price to be paid being $90,000. For the photographs from which our illustrations are made we are indebted to Mr. Chas. McGovern, of Cohoes, N. Y.

Fig. 1.—THE NEW STATE DAM, COHOES, N. Y.—THE IRON APRON.

Fig. 2.—THE NEW STATE DAM, COHOES, N. Y.—SHOWING THE TOP FRAME.

Liquid Chlorine.

Chlorine in liquid form is now being manufactured by Messrs. Pechiney & Co., of Salindres, in France, and at the Rheinania Works, at Rheinau, near Mannheim, in Germany. The gas is liquefied by subjecting it to a pressure of 50 atmospheres (750 lb.) to the square inch and stored in strong iron vessels holding 120 lb. each. It is delivered from these vessels either in the liquid or gaseous form, and can be used in bleaching. It is said to be as economical in use as bleaching powder, while it has some advantages over that product. It is said, however, that the railway companies consider the liquid highly dangerous, and make difficulties as to carriage.

AT the late meeting of the Zoological Society of London a most remarkable instance of evolution in the adaptation of animal organisms to their environments was demonstrated. Mr. Tegetmeier said that the English rabbits imported into Australia were gradually changing their habits and becoming tree climbers, the available food for them there being largely the bark and leaves of trees. In evidence of his assertions he showed the feet of some Australian rabbits, which showed that they are slighter than those of their English progenitors, and their claws are longer and sharper.

Crystallized Sunshine.

We use it daily in a myriad of forms and combinations. It is a chief and important article of food which we call sugar. The sparkling cubes which we buy for a nickel per pound are lumps of crystallized sunshine, or, if you please, concentrated energy. The growing cane absorbs carbonic acid gas from the air, throws off oxygen and deposits carbon in the plant. The carbon combines with hydrogen and oxygen given up from the water absorbed by roots and from the atmosphere. From a single pound of sugar cane we may obtain 2,800 grains of carbon. In these bodies of ours, often called human furnaces, we burn sugar, and so great is its heat-giving power that ten grains of cut-loaf sugar, when consumed in the body, will produce sufficient heat to raise 8·61 pounds of water one degree F., which is equal to lifting 6·649 pounds one foot high. (Edward Smith.)

Some chemists call this force potential energy. It is stored up in different sorts of food in varying volume. There is as much or more in starch than sugar, but in the case of starch it must first be converted into sugar, which the system does as soon as it enters the mouth. Sugar is the very best example of respiratory food, because its action in the system is rapid, and, as a general rule the sugar is fully decomposed or destroyed—burnt up, which is not the case with foods consisting largely of albumen. One ounce of sugar burnt up in the system gives four times more of energy than one ounce of Bass' ale, 25 per cent more than one ounce of cooked beefsteak, nearly four times as much as can be obtained from a like quantity of potatoes.

Crystallized sunshine, as it is turned out in sparkling cubes, or as a granulated mass from the huge, smoke-begrimed brick structures that are such conspicuous objects along the river front of New York, Philadelphia and the bay of San Francisco, plays a very important part in our dietary. And until recently it had a very important part in Uncle Sam's economy, for we find that during the past twenty-five years (1866-1891) sugar placed over $1,000,000 in the national treasury in the shape of a duty or a tax on the energy-building power of the people. It is not any wonder, then, that sugar plays a very prominent part in the political world. It is a splendid source of financial strength to many governments, as it is a physical strength to those who are its consumers.

Chemically considered, there are several sorts of sugar, but using the term in its general sense, we may say that it can be obtained from linen rags and sawdust, as well as from beets and other roots, maize, sorghum, the palm and the cane. The chemical production of fruit sugar, grape sugar or glucose, which will not crystallize, is very different from that of cane or beet sugar. If one atom of water could be eliminated from a molecule of glucose, we would have a chemical formula identical with cane sugar. Will it be the same, if the change is ever brought about? Some chemists claim it will, but nature, in her laboratory, makes different things from the same chemical formula, and has tricks of combination that defy our power of research and investigation.—*American Grocer.*

Amalgam Cement for Porcelain.

A very stable and lasting cement for articles of porcelain that do not have to be submitted to a very great degree of heat is made, according to the *Farben Zeitung*, as follows: First prepare a fine powder of metallic copper, by shaking a solution of copper sulphate with granulated tin. Wash the powder well after precipitation. The proportion of this powder will vary according to the desired hardness of the cement (which is, in fact, an amalgam), and may run from 30 to 36 parts, the rule being the more copper, the harder the cement. Place the desired quantity in a porcelain vessel and add to it sufficient sulphuric acid of 1·85 s. g. to make a pasty mass. Add at once 70 parts of metallic mercury and stir constantly until a homogeneous amalgam is obtained. Wash with plenty of warm water until all the sulphuric acid is removed. To use this amalgam it must be heated until it becomes likes wax. The edges of the article to be united should also be heated to about 375° C. (about 706° F.) When applied to the heated amalgam a portion of the latter will attach itself to the edges, which may then be joined. As soon as it is cool the article is ready for use. It will then stand heat up to 500° F. without any danger.

Vesuvius.

Professor Palmieri writes: "Vesuvius, the activity of which was rather increased last full moon, and then decreased during the last few days, has again commenced to show signs that we may expect new eruptions and flows of lava. From the principal crater much smoke issues, and detonations are heard and redhot stones are thrown out. The eruptive cone in the Atrio del Cavallo emits smoke from its summit with a certain force, while from its base the lava flows more rapidly. A smaller cone in the same place is not quite so active. For many days the seismic instruments have maintained a constant movement which tends to increase."

THE PHOTORET.

This is the name given to a complete little photographic camera, an American invention, which eclipses for compactness and novelty anything of the kind that has come under our notice. It resembles in outward appearance a nickel-plated watch, and is readily operated with one hand. The lens is rather minute and of fixed focus, but still makes a sharp, small picture which can be subsequently enlarged four or five diameters to advantage. What appears to be the ring and stem of the watch is the releasing pin for the shutter and for revolving the lens, bringing it into a new position for the next picture, and at the same time winding up the shutter spring. There are also numbers stamped on the periphery of the lens holder which indicate the number of pictures that have been taken; these numbers show as the outer case is rotated. On the front is a small pin-hole called "time stop." If a common pin is inserted here and the stem of the watch be pressed as shown, the lens will remain open as long as the pressure is maintained, and a time exposure may thus be made.

The camera is loaded by unscrewing the back and inserting the sensitized thin film of celluloid face downward. On this film six small pictures may be made. Then in a dark room the film is removed and another inserted. These films are supplied with the camera in special boxes, each containing a compartment holding six fresh films and a vacant one for holding the exposed films. Enough films are supplied with each camera watch to make thirty-six different pictures. There is also a small book of concise directions, which describe fully the method of operating the camera and of making the pictures. The price at which the camera is sold is very low, and it is certainly an article of no inconsiderable utility. Small as it is, it is useful, not only to the beginner in photography, but to those who are experienced in this beautiful art. There are many situations in which the taking of a photograph by means of a pocket camera like this becomes desirable and even important; situations, in fact, in which it would be impossible to use a large instrument. At all times and in all places it is useful. With it the owner may take snap shots of people, of animals, buildings, machinery and objects of nature. The student of science may use it in microscopical illustration. For the preparation of lantern slides it is especially convenient and yields excellent results.

Workers in almost every profession or trade may derive valuable assistance and be enabled to carry to their offices or work benches ideas and effects, many of which will repay a hundredfold the time and attention bestowed on them.

The design of a fabric, the draping of a garment or hanging, a striking effect in architecture, etc.—these, and, in fact, any and everything visible which would suggest itself as desirable to the operator, can be captured.

Independently of the greater uses, such as we have indicated, we welcome the advent of such contrivances as this, because they are of special interest to the young, and contain the elements for much harmless amusement and enjoyment. How much better it is for young folks to be occupied in picture taking than in learning cruel sports, such as bird shooting, pistol firing, etc. The boys and girls, as well as grown people, are likely to be delighted with this little invention.

We give a specimen of the portraiture produced by means of this camera. The small face is that made by the photoret, of which the larger face is an enlargement.

Further information may be obtained from the manufacturers, the Magic Introduction Company, 321 Broadway, New York City.

The Motions of the Diamond.

Sir R. Ball, who is fond of revealing the marvelous, has been studying the mysterious action of molecules; and what he has to say concerning the movements of the molecules of a diamond is as truly surprising as anything he has told us about the sun and the planets. Every body is composed of a multitude of extreinely, but not infinitely, small molecules, and it might be thought, says Sir Robert (according to a contributor in the *Newcastle, Eng., Chronicle*), that in a solid, at all events, the little particles must be clustered together in a compact mass. But the truth is far more wonderful. Were the sensibility of our eyes increased so as to make them a few million times more powerful, it would be seen that the diamond atoms, which form the perfect gem when aggregated in sufficient myriads, are each in a condition of rapid movement of the most complex description. Each molecule would be seen swinging to and fro with the utmost violence among the neighboring molecules and quivering from the shocks it receives from the vehement encounters with other molecules, which occur millions of times in each second. The hardness and impenetrability so characteristic would at first sight seem to refute the supposition that it is no more than a cluster of rapidly moving particles; but the well known impenetrability of the gem arises from the fact that, when attempt is made to press a steel point into the stone, it fails because the rapidly moving molecules of the stone batter the metal with such extraordinary vehemence that they refuse to allow it to penetrate or even to mark the crystallized surface. When glass is cut with a diamond, the edge which seems so hard is really composed of rapidly moving atoms. The glass which is cut is also merely a mass of moving molecules, and what seems to happen is that, as the diamond is pressed forward, its several particles, by their superior vigor, drive the little particles of glass out of the way.

Gardening by Electricity.

By the use of electric light the Hon. W. W. Rawson, of Arlington, Mass., claims that he makes a gain of five days in each of his three crops of lettuce—that is, two weeks in a season—that the gain on one crop pays all the expenses of the electric lighting for the season, thus giving him the gain on the other two for extra profit. His attention was first called to the usefulness of the light by the advance made in the growth at the ends of his greenhouses next the street and in the glare of the electric light. This was so marked that he introduced the light through his lettuce and cucumber houses. Dr. Baily, of Cornell University, says, as the result of his own experiments, that the influence of the light is greatly modified by the interposition of a glass roof. Plants injured by a naked light were benefited by the protected light. Five hours' light per night at a distance of twelve feet hastened maturity a week or ten days, but proved injurious to young plants and those newly transplanted.

A Word to Mail Subscribers.

At the end of every year a great many subscriptions to the various SCIENTIFIC AMERICAN publications expire.

The bills for 1894 for the SCIENTIFIC AMERICAN, the SCIENTIFIC AMERICAN SUPPLEMENT, and the ARCHITECT'S AND BUILDER'S EDITION of the SCIENTIFIC AMERICAN are now being mailed to those whose subscriptions come to an end with the year. Responding promptly to the invitation to renew saves removing the name from our subscription books, and secures without interruption the reception of the paper by the subscriber.

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Correspondence.

To Prevent Frost on Windows.

To the Editor of the Scientific American:

If F. P. R., in query 5481, November 18, will make his glass double, leaving one-half inch or more space between, and make it air-tight, he will have no more trouble with frost. I have used windows made in that manner for fifteen years, and never saw any frost on them when the space between the glass was air-tight.

W. DAYTON.

Wallingford, Conn., December 4, 1893.

Watching for Shed Fires, Central Pacific Railway.

To the Editor of the Scientific American:

On page 346 is an article under the heading "Snow Sheds of the Union Pacific." The locality described is on the Central Pacific.

In this connection it may be of interest to some of your readers to know that as a further guard against fire a watchman is located high up the mountain side, at Cisco, from which vantage ground he has in view almost the entire line of these forty-odd miles of sheds. Part of his apparatus consists of a dial, with a pointer so arranged that in case of fire at night, by bringing the pointer in line with the blaze and then consulting the dial he is at once able to locate the fire and give the alarm to the fire train at Summit.

The enormous cost of the structure causes the company to take every precaution to guard against its destruction.

WM. L. PATTIANI.

San Francisco, December 1, 1893.

Steam, Heat and Water.

BY JOHN E. TAYLOR.

Steam is pure water expanded by heat into an invisible vapor. Perfect steam is in no way moist, but is as dry as are the permanent gases. It has in a complete degree those properties of fluidity, mobility, elasticity and quality of pressure in every direction that distinguish gases.

Saturated steam is the normal condition of steam generated in free contact with water, and the same density and same pressure always exist in conjunction with the same temperature. It therefore is at both its condensing and generating points, *i. e.*, it is condensed if its temperature is reduced, and more water is evaporated if its temperature is raised.

The pressure and density of steam, generated in free contact with water, rise with the temperature, and reciprocally its temperature rises with the pressure and density. The higher the temperature the more exactly proportionate to the variations of temperature. Under this condition, steam is termed "saturated" from its containing the largest amount of water possible at any given temperature.

The pressure of steam at a boiling point of 212° is equal to the pressure of the atmosphere, which is 14·7 lb. upon a square inch.

The expansive force of the vapor of all fluids is the same at their boiling points.

A cubic inch of water evaporated under ordinary atmospheric pressure is converted into 1,640 cubic inches of steam, or nearly one cubic foot, and it exerts a mechanical force equal to raising $14{\cdot}7 \times 144 = 2{,}120$ lb. 1 foot high.

One pound pressure of steam will support a column of mercury = 2·0376 inches high.

The boiling point of water varies with the pressure of the atmosphere or vapor under which it is effected.

Steam for heating purposes possesses an advantage over hot water in the ease of its application where great inequalities and frequent alterations of level occur, and particularly when the boiler must be placed higher than the place to be heated. For buildings occupied at intervals, steam is more effective than hot water in its rapid generation of heat.

The most prominent of the properties of steam are its high expansive force, its condensation by the abstraction of its temperature, its concealed or undeveloped heat, and the inverted ratio of its pressure to the space it occupies.

The expansive force of steam arises from the absence of cohesion between and among the particles of water. If a known volume of steam of a certain pressure be made to occupy but one-half of its volume, its elastic power will be doubled.

Steam has an expanding force always equal to the pressure under which it is generated, and its temperature theoretically is always the same as that of the water in contact with it.

The sum of its sensible and latent heat is always the same and is equal to 1,146° above the freezing point of water. Under ordinary atmospheric pressure 27·222 cubic feet weigh one pound, and it has a gravity about equal to one-half that of air at 34°; but if the temperature of air be increased 160°, the gravity of steam will equal two-thirds of the weight of air.

HEAT.

Heat is simply a mode of motion or an influence by which motion is produced among the atoms of substances. The motion is imperceptible, heat being detected only by sense of feeling.

It is a universal force, and is referred to as cause and effect. Heat and cold are conditions and not substances. They are relatively, not absolutely, different, being merely higher or lower degrees of heat.

The three most apparent effects of heat, so far as they relate to the form and dimensions of bodies, are expansion, liquefaction, and vaporization. Its effect is most evident in those bodies which are the least influenced by the attraction of cohesion; thus in solids it is comparatively trifling, in liquids it is much greater while in gases it is very considerable.

The force with which bodies expand and contract under the influence of an increase or diminution of heat is irresistible, and is one of the greatest forces in nature.

The ratio of expansion in solids and liquids increases with temperature, while in gases it is sensibly uniform at all temperatures.

A unit of heat is the quantity of heat necessary to raise 1 lb. of water 1° F.

Specific heat is the capacity of a body for heat, and is the number of heat units necessary to raise 1 lb. of any substance 1°. The specific heat of all bodies, except gases, increases with their temperatures.

Latent heat is the number of heat units absorbed by any body in passing from a solid state to a liquid or from a liquid to a gaseous condition.

Heat is transmitted or lost by radiation—projected in rays and in straight lines. By convection rising in fluid masses or through flues. By conduction—passing from one body to another in contact.

The heat necessary to warm a pound of water 1° will warm about 4·2 lb. of air 1°, or 2·1 lb. of vapor of water, or 9 lb. of iron, or nearly 2 lb. of ice one degree. The heat necessary to convert 1 lb. of water from 178° (which is about the temperature of return water) to steam is about 1,000 units, and this will heat 52,000 cubic feet of air 1°, or 5,200 cubic feet 10°, or 52 feet 100°, without making allowance for the increase of its bulk because of its expansion, which for a difference of 100° will equal nearly 20 per cent of its original bulk.

WATER.

Whether as a solid, liquid, or gas, water is one of the most wonderful substances in nature. At all temperatures above 32° F. the motion of heat is sufficient to keep its molecules from rigid union; but at 32° the motion becomes so reduced that the atoms seize upon each other and aggregate to a solid.

It is composed by a chemical union of oxygen and hydrogen in the proportions of: By weight, oxygen, 88·9 parts; hydrogen, 1·11 parts. By volume, oxygen, 1 part; hydrogen, 2 parts.

Liquids transmit pressure equally in all directions, unchanged and without loss of power. This equality of pressure is their most characteristic property.

Water at 1,000 ounces is assumed as unity in the comparison of gravity of different substances.

It evaporates at all temperatures, dissolves more substances than any other agent, and has a greater capacity for heat than any other known substance except hydrogen gas.

Twenty volumes of water absorb one volume of air under atmospheric pressure.

A miner's inch is a measure for the flow of water, and is an opening 1 inch square through a plank 2 inches thick, under a head of 6 inches of water, to the upper edge of the opening. It will discharge 11⅝ gallons in one minute.

A cylinder 3½ inches in diameter and 6 inches high will hold almost exactly one quart, and one 7 inches in diameter and 6 inches high will hold very nearly one gallon.

The ratio of fresh water to salt water is about as is 36 to 35 by weight.

Radiation is effected by nature of surface of body; thus, black and rough surfaces radiate and absorb more heat than light and polished surfaces.

Bodies which radiate heat best, absorb it best.

Radiant heat passes through moderate thicknesses of air and gas without suffering any appreciable loss or heating them. When a polished surface receives a ray of heat, it absorbs a portion of it and reflects the rest. The quantity of heat absorbed by the body from its surface is the measure of its absorbing power, and the heat reflecting, that of its reflecting power.

When temperature of a body remains constant, it is in consequence of quantity of heat being equal to quantity of heat absorbed by body.

Reflecting power of a body is complement of its absorbing power; or sum of absorbing and reflecting powers of all bodies is the same. Thus, if quantity of heat which strikes a body=100, and radiating and reflecting power each 90, the absorbent would be 10.

Air and gases are very imperfect conductors. Heat appears to be transmitted through them almost entirely by conveyance, the heated portions of air becoming lighter, and diffusing the heat through the mass in their ascent. Hence, in heating a room with air, the hot air should be introduced at lowest part. Convection of heat refers to transfer and diffusion of heat in a fluid mass, by means of the motion of the particles of the mass.

A low pressure gravity apparatus is the most healthful, economical, cleanly, and perfect heating appliance known, and may be constructed to heat a single room or the largest building with a uniformity that cannot be attained by any other means.

A gravity apparatus is one without an outlet whose circulation is perfect, wasting no water and requiring no mechanical means for returning the water of condensation to the boiler. It has been very properly likened unto the circulation of blood in the human system.

This form of apparatus is extensively employed in warming private houses, churches, schools, and other public buildings, with very satisfactory results. Its chief merits are its safety, noiselessness, the ease with which it is managed, the low and uniform temperature of its surfaces, and the positive return of the water of condensation to the boiler under all conditions.

A low pressure gravity circulation apparatus consists of the boiler with its various attachments for the automatic regulation of its draughts and pressures; main steam pipes and risers for conveying the steam to the various parts of a building to be warmed, and the corresponding return risers and mains for the return of condensation to the boiler; relief pipes for relieving the mains and risers of the water of condensation, and for equalizing the pressure throughout the apparatus; radiators for the several rooms to be warmed, with their necessary valves and connections.—*Master Steam Fitter.*

Astronomical Notes.

Professor E. E. Barnard, of the Lick Observatory, recently gave a lecture on astronomy in San Francisco, which is spoken of by the *Scientific and Mining Press* as having been interesting. Many stereopticon illustrations were shown. Professor Barnard said that photography had enabled the astronomers of to-day to see that of which their brethren of a few years ago had never dreamed. Even the trained eye of the most eminent astronomer begins to grow tired after looking through a telescope a minute, and after that his vision becomes less acute. Any object that he fails to notice in that short time passes by unseen. The plate in a camera, however, may be left exposed for hours, during which time even the faintest star will have left at least some slight trace.

About sixty stereopticon views were presented, showing some of the most interesting of the heavenly bodies under varying conditions. In a photograph of the moon's surface could be seen the dark areas called seas and the vast lunar craters.

A picture of the sun's disk revealed a sun spot said to be three times as large as the earth. Ragged-looking holes that looked as if they had been made by a tremendous explosion were plainly visible, and were said to be shattered places in the sun's atmosphere.

Two drawings of the planet Mars were particularly interesting. It will be remembered that this brilliant neighbor of ours is about 35,000,000 miles distant from the earth, and therefore the difficulty of obtaining an accurate representation of it may be imagined. The planet as a whole is of an ocher cast, but the trained eye of the astronomer detects little green spots, believed to be water, and others supposed to be land. At the poles are white spots, evidently ice and snow. This white region diminishes in density as it approaches the equator, and finally disappears altogether. Professor Barnard said that these spots increase in extent as the planet moves away from the sun and the temperature presumably grows colder, thus tending to substantiate the theory that the poles of Mars are surrounded by ice and snow, as are those of the earth.

The streak across the sky commonly known as the Milky Way becomes a thing of beauty when reproduced on canvas by means of a camera. The clouds of countless stars, each one a great sun in itself, assume an added brilliancy that one would hardly suppose exists when looking at them with the naked eye. It requires four hours for this collection of heavenly sparklers to make an impression on the supersensitive plate of a camera, and during all this time the camera is moved by clockwork to keep pace with the stars as they seem to be winging their tireless way through space. The great comet of 1882, which startled all the world with its long tail, was reproduced with startling effect. This comet has a tail 100,000,000 miles long, and will not be again visible to the inhabitants of the earth until 800 years have passed away.

Good Lemonade.

For a quart I take the juice of three lemons, using the rind of one of them. I am careful to peel the rind very thin, getting just the yellow outside; this I cut into pieces and put with the juice and powdered sugar, of which I use two ounces to the quart, in a jug or jar with a cover. When the water is just at the tea point I pour it over the lemon and sugar, cover at once and let it get cold. Try this way once, and you will never make it any other way.

THE TRAVELING GARBAGE BURNER OF CHICAGO.

The disposal of garbage and other refuse from the household is the most serious hygienic question that municipal governments have to deal with, as the health of a city depends to a large extent upon the efficiency of the street cleaning department. The most common method of removing garbage is by means of carts that go from house to house gathering whatever refuse there may be until the wagon is loaded, then through the streets with the foul-smelling and disease-breeding load to a distant dump, which, in cities on the sea coast, may be a scow, but which in most cities is more liable to mean a depression in the ground, which is filled with this putrid matter and left to contaminate the whole region.

An effectual way to dispose of garbage is to burn it, and this can be accomplished either by the use of stationary or by portable crematories. One great hindrance to a satisfactory and economic system of collecting and destroying it is the fact that to the garbage are added ashes, old shoes, bottles, tin cans, paper and household refuse of all kinds.

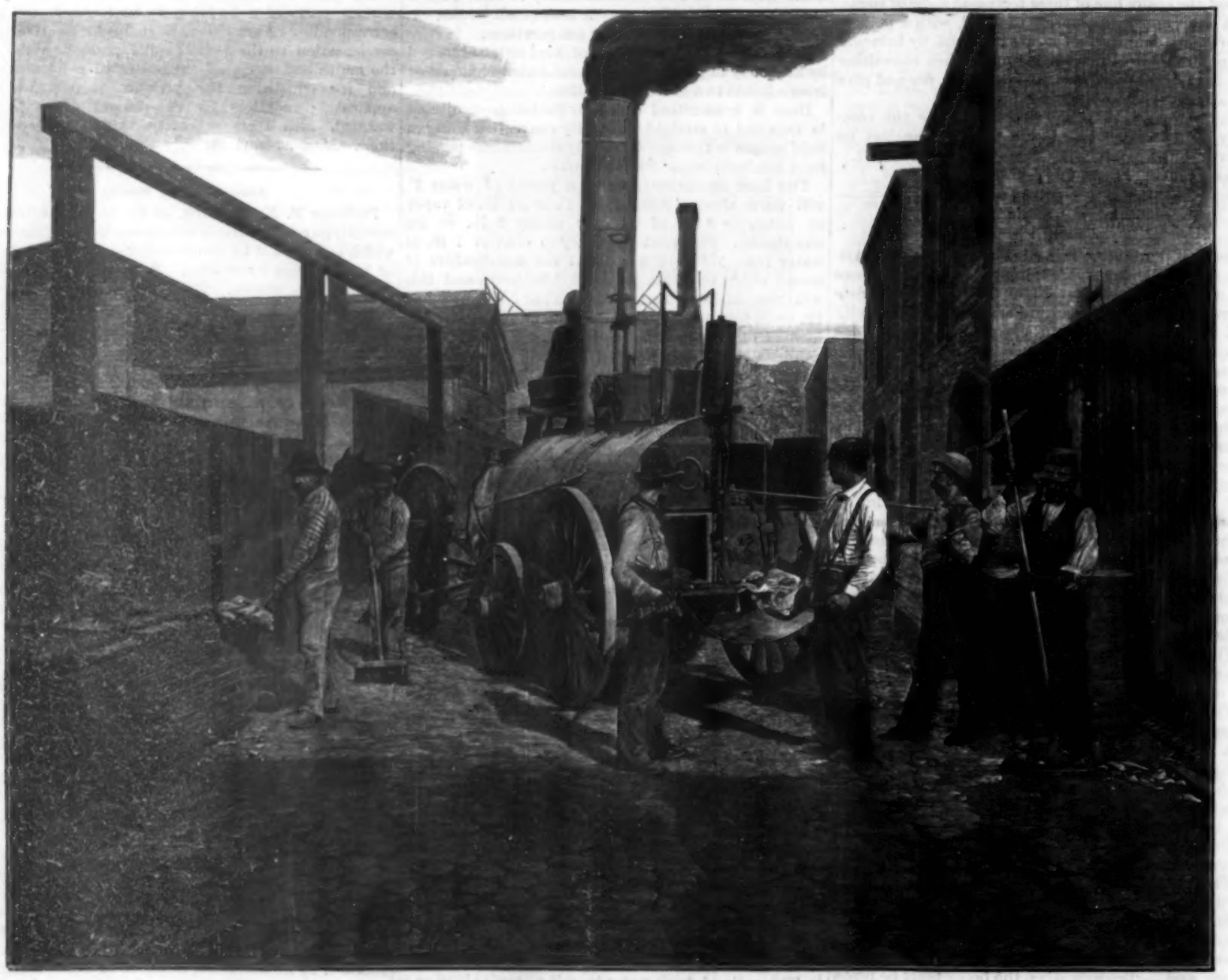
The city of Chicago has taken hold of this matter with much vigor and has tried both stationary and portable crematories. Superintendent Welles, of the street cleaning department, was not satisfied with the results obtained; so devised a crematory of his own, which is shown in the accompanying illustration, as it appears in actual work in an alleyway on the west side of Chicago. It is a very simple affair and made solely for service, all regard for appearance being thrown aside. This crematory has produced decidedly satisfactory results, and Mr. Welles regards it as the most successful one that has yet been produced, all things considered.

The crematory weighs 7,700 pounds and is drawn by a pair of horses. It comprises a cylinder eight feet long and four feet in diameter, made of ordinary boiler iron covered with abestos. A tall smokestack in front completes it, the whole being mounted on wheels. The general appearance of the crematory is not much unlike a traction engine. The cylinder is divided longitudinally into three compartments, two of which can be seen in the illustration, half of the double door to each being open. The upper compartment is the furnace proper and the lower one is the ash pit. In the forward part of the cylinder is a third compartment, the grate of which is inclined toward the front end. On the top is a receiving box into which the garbage is thrown and where it is subjected to sufficient heat to drive out most of its moisture. When the box is filled a rod attached to the sliding bottom is pulled out and the contents dropped into the furnace, where the intense heat incinerates it instantly. While this burning process is going on an attendant pushes the burning mass into a forward compartment, which contains an inclined grate, in order to keep the consuming capacity of the furnace up to its highest mark. The fire is maintained by the use of crude petroleum. Two cans designed to hold this fuel are used; one is on the rear end, immediately over the furnace doors, and the other is forward. The flow of this fuel is easily regulated by a stopcock, so that if the fire becomes low it can be enkindled almost instantly, making the crematory a roaring furnace. Frequently, when in operation, the smokestack reaches a white heat, so intense is the heat generated. The capacity of this furnace is enormous, and ordinary garbage disappears in it like paper.

Only the garbage proper is fed into the receiving box on the top. All paper and other light, inflammable material is fed into the rear door immediately into the fire. One man is represented in the illustration as about to throw a shovelful of paper into the furnace, while another has just removed a shovelful of garbage from the garbage box, preparatory to throwing it into the receiving box. The man at the right with the rake in his hands assists in separating ashes from the garbage proper, and rakes up into piles whatever cannot be burned ready for the wagon that follows the crematory to gather up. Most of the alleyways in Chicago are paved with wooden blocks, and, in order to prevent any danger of their being set on fire from hot coals, a sheet iron apron, as shown in the picture, is stretched under the furnace door to gather all falling embers.

The crematory is followed by a wagon which gathers up ashes, bottles, tin cans, and other refuse that cannot be consumed. Four or five times in the course of a day the ashes are drawn from the crematory in order to give it good draught, but this little residuum takes a very small fraction of the space that the burned garbage occupied, and all disease-breeding germs are consumed. The ordinary day's work of this traveling crematory, and the two refuse carts which follow it, is twenty-three blocks, although there have been occasions when thirty blocks have been covered. This means a large amount of work in a city like Chicago, where in most instances eight blocks equal a mile. When the crematory and tender have been through an alleyway the transformation is surprising, as the place has been cleaned of disease-breeding refuse and other litter. It is estimated that this outfit of traveling crematory and wagon will take the place of fifteen to twenty ordinary garbage wagons, and it has a special advantage over them in that everything subject to decay is burned on the spot where it is gathered and foul odors are not stirred up and carried through busy streets, risking the spread of disease. Whatever noxious gases arise from the smokestack are soon dissipated, and the crematory, after disposing of the garbage on one block, moves along to the next, so that there is not a constant stream of such gases being poured out from one source as would be the case in a stationary furnace.

No comparison of this system of disposing of garbage over the garbage cart system has been made to a sufficient extent to admit of giving any definite figures, but enough has been learned to lead the street cleaning department of Chicago to believe that the portable crematory is vastly more efficient than anything that has yet been attempted in that city and is less expensive. It is estimated the cost of the crematory and men to manage it and two teams to remove the ashes and other refuse is less than $20 a day.



THE TRAVELING GARBAGE BURNER OF CHICAGO.

Avalanches Produced by Railways.

A correspondent to the London *Times* records a curious and altogether unexpected result of the tunneling operations in the St. Gothard is a lawsuit instituted by the inhabitants of the adjacent valleys. They sue the federal government for damages caused by the great increase of avalanches which constantly thunder down the mountain side, produced, it is presumed, by the explosions of dynamite more than by the vibrations of passing trains in the lower tunnels of the railway. Many witnesses, who have lived in the neighborhood since the early part of the century, will swear to the greatly augmented number and force of the avalanches that now constantly sweep destruction down the mountain. The first hearing of this novel case was lately heard before the federal judges assembled at Bellinzona. We believe there is no instance in this country of an avalanche produced by railway service.

La Navarre, New French Passenger Steamer.

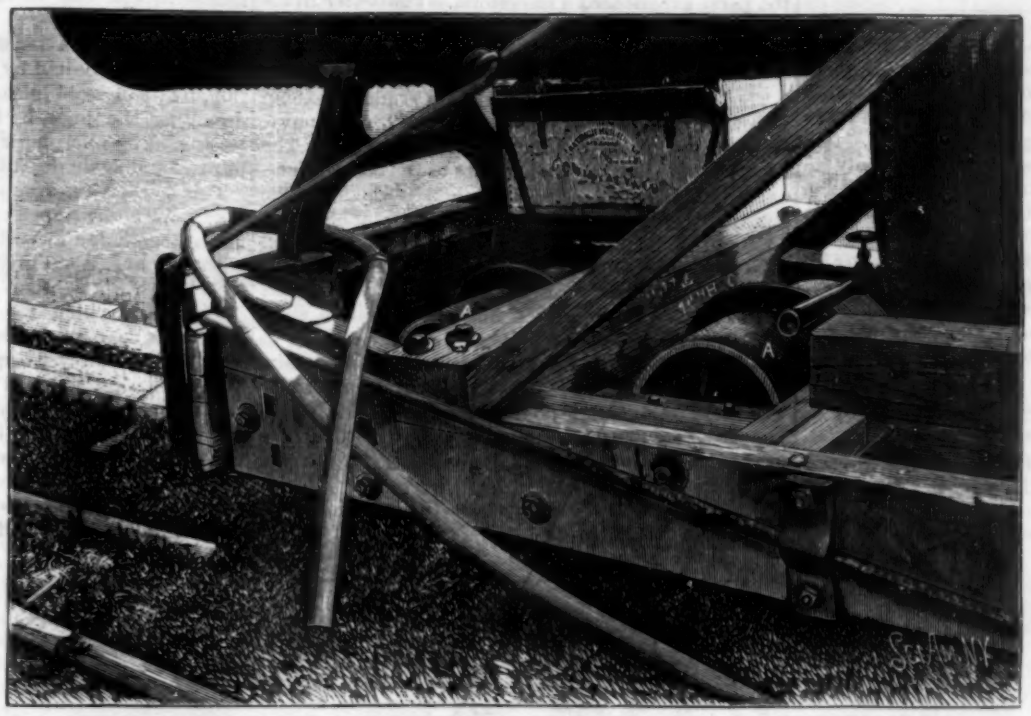
La Navarre was launched from the yard at Penhoet St. Nazaire, and is built of steel. *Engineering* says she is divided into fifteen compartments by thirteen transverse bulkheads, and a longitudinal bulkhead in the engine room. There are four complete decks; the promenade deck extends half the length of the vessel. The vessel is 494 feet in length and 49 feet 3 inches beam, with a depth of about 37 feet. Her displacement is 8,922 tons at a loaded draught of 22 feet 8 inches. The vessel is, of course, propelled by twin screws, driven by triple expansion engines. Each set develops 3,750 horse power, showing a total power of 7,500, with 90 revolutions a minute. The cylinders are 31½ inches, 50¼ inches, and 82½ inches in diameter, with a stroke of 52½ inches. Each engine has its own condenser, 14 feet 1 inch long, 6 feet broad, and 10 feet 10 inches high. The total length of the tubes is upward of 27 miles. The boilers are double ended, four in number, and having a total of twenty-four furnaces of a diameter of 47 inches. There are four ventilating fans for forced draught. The propellers are of gun metal and their diameter is 15 feet 4 inches. The funnels, two in number, are elliptical, the greater diameter being 8 feet 10 inches, and the lesser 5 feet 3 inches. She is furnished with two masts, and these do not carry yards. Accommodation is afforded for 250 saloon, 54 second and 74 third class passengers. In addition to this, on the lower deck no less than 600 emigrants can be berthed. For the purpose of the proper separation of the sexes, these are carried in three separate divisions. The first class passengers are of course amidships. The dining saloon on the upper deck will seat 152 persons at one time. There are small tables at the sides for private parties, as well as the long tables in the middle of the room. This room is 66 feet long and 32 feet 9 inches broad. The *salon de conversation*, or, as the Americans will doubtless call it, "the social hall," is about 40 feet long, and is lighted by a dome as well as by the usual side port holes. The decoration of this room has been particularly attended to, and the walls are paneled with marqueterie. The usual smoke rooms, barber's shop, and bath rooms are not forgotten. On the main deck are the children's dining saloon forward, and the second class passengers' dining saloon aft. The cabins *de luxe* and family cabins are on the promenade deck. La Navarre is lighted throughout by electricity, there being 742 lights on board. There is also a refrigerating apparatus on the Fixary system for the manufacture of ice and for the preservation of the fresh provisions. This vessel is capable of being used as an auxiliary in time of war. La Navarre attained a speed of 18 knots on trial without being forced.

A Work on the Railway Exhibit at the World's Fair.

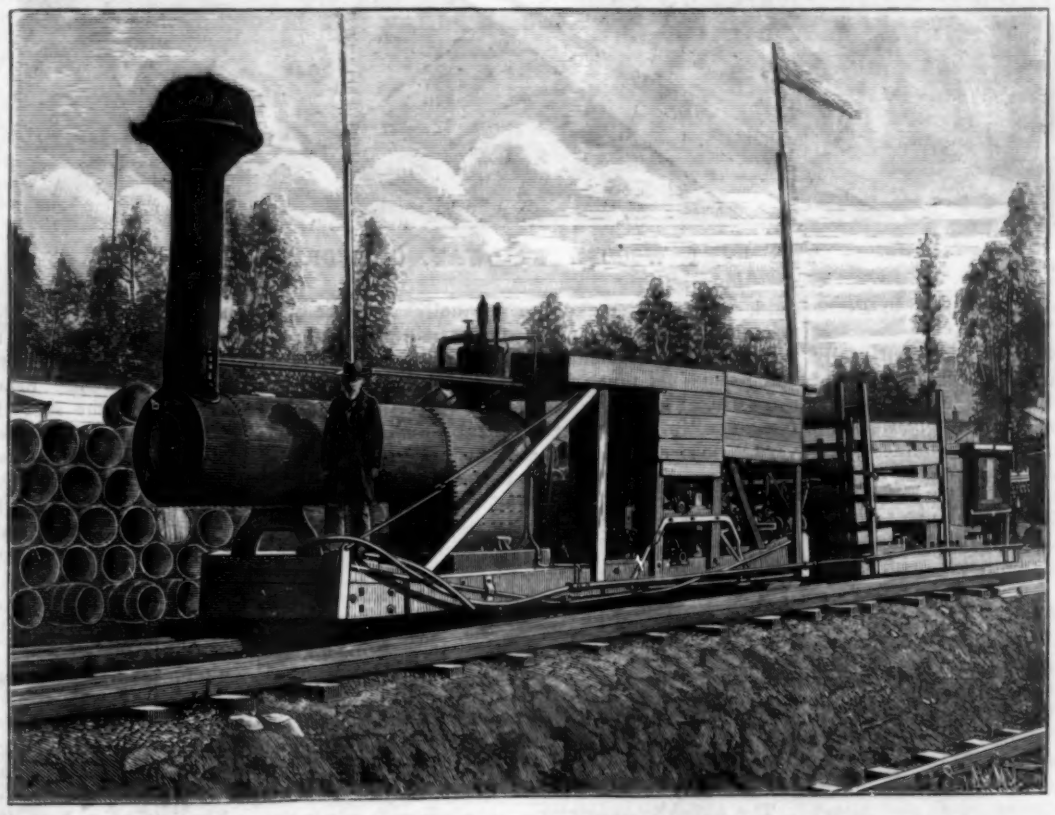
Our readers know how interesting a railway exhibit was presented at the World's Columbian Exposition. Mr. J. J. Pangborn, United States Honorary Commissioner, is preparing to issue an *edition de luxe* of a book devoted to this subject. In size it will be a large octavo, and is to be sumptuously printed and illustrated. The use of color in the cuts adds greatly to the appearance of the book, and it will meet with a warm reception at the hands of those who appreciate an interesting subject so carefully and expensively presented. It is to cover the entire period of development of the locomotive and railway; it will have one hundred and fifty-three color plates, and the same number of single color plates. There will be 160 pages, printed on hand-made paper.

The Magnetization of Steel Rails.

Some interesting experiments have been carried out by M. Vinot, a French engineer, in regard to the magnetization of steel rails. A portion of the line between Bordeaux and Cette was utilized, the left hand track serving for the trains coming from the latter town, while on the right hand track the trains run in the opposite direction. On the experimental station chosen the rails were laid in a direction at right angles to the magnetic meridian, or in other words, from west to east, and it was found that when a pocket compass was placed on one of the joints in the left hand track, the needle pointed exactly in the direction of the line of rails, the north pole being turned toward the town of Cette. With the same compass similarly placed on the right hand track, the needle again pointed in the direction of the line of the rails, but the north pole this time was turned toward Bordeaux. The secret of this singular phenomenon was conclusively demonstrated. The distances allowed for expansion between rail ends varied from about one-tenth to one-half inch, producing a very perceptible shock on the passage of trains, from the respective depressions and elevations of the ends of the rails and their influence on the car wheels, and these shocks, it was found, developed a south polarity in those rail ends in which the concussion took place.



FRONT END OF THE BURT LOCOMOTIVE, SHOWING FLANGED WHEELS.



THE BURT LOCOMOTIVE ENGINE AND FREIGHT CAR

THE BURT WOODEN RAILWAY, CALIFORNIA.

Mr. John James Burt, originally a lawyer, owns a valuable marble quarry and lime kilns at Cienega, about 12 miles from Tres Pinos. Four kilns and forty men are employed producing lime. To carry the lime to the main railroad line, Mr. Burt has built a wooden railway about 12 miles long, which connects with the terminus of a branch of the Southern Pacific road at Tres Pinos. Mr. Burt's railroad rests on 5 foot ties, 4 by 6 inches square, and about 2 feet apart. On these the longitudinal wooden sleepers are laid, made of 3 by 4 inch scantling, each rail consisting of three pieces laid side by side, and forming a continuous wooden floor or pathway 24 inches broad, except that a narrow slot is left in the center of the floor. On this floor the engine and cars travel, being carried by broad centrally flanged rollers or wheels, marked A A in the cut of the front end of the engine. These rollers are a little over 24 inches long and are provided with a central flange which enters the slot between the rails and prevents the engine from leaving the track. A recent patent of Mr. Burt's provides for making the rollers in two halves, half of the flange being cast on each section. The sections are then mounted so as to rotate independently of each other. This is to secure ease in turning curves. The road is a private one, its rights being granted by the county supervisor. Considerable grades exist on the road, which are readily overcome. One of our views shows the engine with one of the freight cars, Mr. Burt standing on the forward end. Another engraving (see next page) shows the lines of rail passing over a trestle and extending back into the country. The arrangement of the wheels with their central flanges is shown in the view of the front end of the boiler. The system is a novel one and has features which might make it of very great utility in some regions of the country. It may be accepted by our readers as a further contribution to the history of rails which formed the subject of an article in a recent SCIENTIFIC AMERICAN.

The marble quarry of J. J. Burt, Esq., is situated in the hills at Cienega, about twelve miles from Tres Pinos, and is known as the Cienega Lime and Marble Quarry. It is one of the largest deposits of marble in the State, while none of finer quality can be found anywhere. The locality where this marble is found was purchased by Mr. Burt some years ago. He has been supplying all parts of the State with lime for some six years, and it is of such superior quality that it brings 25 cents more per barrel than any other on the market.

The mountains containing this valuable marble are 1,500 feet high and run some six miles back. This marble can be seen cropping out in every direction. In fact, there is no end to it. A remarkable fact in this connection is that the present workings are in a canyon, on the opposite side of which from the marble ledges is a vast deposit of granite of good quality. Thus the two valuable building stones may be quarried out at one and the same time. There is a very large area of both marble and granite, comprising several hundred acres. To say there are a thousand fortunes in this property is putting it mildly.

Mr. Burt, up to the time of his purchasing this valuable property, was a leading lawyer in San Jose, but finding his health giving out, he decided to make

a change and find some way to busy himself; he has given up all other engagements and located at the quarry for the purpose of introducing it into the market in the way of monuments, statuary and contracting with builders to furnish it for ornamental purposes.

We are indebted to Mr. J. M. Pickett, of Hollister, Cal., for a set of admirable photographs of the Burt railway. From these our engravings were prepared.

To Trade Mark Appeals.

It has been settled by a decision of the Court of Appeals of the District of Columbia that appeal does not lie to it from the Commissioner of Patents in trade mark disputes. This is an important decision. Disputes between trade mark claimants are commonly referred to as "interferences" in trade marks. Under the law establishing the Court of Appeals of the District of Columbia it is provided that any party aggrieved by a decision of the Commissioner of Patents in any interference case may appeal therefrom to the said court. In dismissing the appeal the court held that the word "interference," as used in the act establishing the court, applied only to patent cases or applications therefor and not to trade mark disputes.

Source of the Mackenzie River.

The great Mackenzie River, the mightiest stream on the American continent, excepting only the Mississippi, has never been traced to its head, and up to the present time the source from which it issues has only been known from Indian report. The mystery has, however, now been solved by R. G. McConnell, of the Dominion Geological Survey, who has just returned from a four months' exploration trip in those regions.

Mr. McConnell arrived in British Columbia from Ottawa in June and started out on his trip from Quesnelle on the 9th of that month. That at least may be said to be the commencement of his trip, as on that day he left civilization behind. The party numbered six in all, and consisted of himself, his assistant, Mr. Russell, who, by the way, is one of the leading hockey players of Canada, two whites he got at Quesnelle and two Indians. From Quesnelle the party proceeded in canoes up the Fraser to Giscome Portage. This is seven and a half miles long, and after crossing it they proceeded down Crooked River to Fort McLeod. Their route then lay down Parsnip River to the forks, where Findlay River meets the Parsnip and gives birth to Peace River.

On reaching Findlay River Mr. McConnell really commenced his summer's work, as the chief object of his trip was to explore that river and, if possible, the Omineca also. Mr. McConnell accordingly went up Findlay River to its junction with the Omineca, and followed the latter river to its head, returning down it again to the same spot. This river is easily navigable on the upper portion, but in the first thirty miles it falls over 500 feet, and is consequently extremely rapid and difficult to ascend. Mr. McConnell then proceeded up the Findlay River.

Whites had been up to the Omineca River previous to him, as at one time that was a famous gold country, but Mr. McConnell and his party were the first whites to ever ascend the Findlay River to its head. The river is about 250 miles long and is navigable for the greater portion of the way in canoes, though owing to the rapids the party had to proceed the last fifty miles on foot, an arduous task, owing to the roughness of the country. The country is very mountainous, and though at the lower part of the river the valley is six miles wide, the mountains come right down to the water's edge in the upper portion.

At its mouth the Findlay is about as wide as the Fraser at Quesnelle. It is not very deep, except in the canons, where the current is very strong, and, owing to the numerous rapids and eddies, progress is very slow. At the head of Findlay River is a lake known in the Indian tongue as Lake Fehutade, which, being interpreted, means "narrow waters between mountains." This lake is the real source of the Mackenzie River. It is between twenty-five and thirty miles long and not more than a quarter of a mile wide, and is inclosed by high mountains.

Around the edge of the lake are glaciers, and the scene is a very pretty one. The mountains rise 5,000 to 6,000 feet above the lake, while they are some 9,000 feet above the level of the sea. After exploring the lake Mr. McConnell started on his homeward journey about the end of August, and it was none too soon, as ice began to form on the river, and while on the Parsnip the party experienced a snowstorm.—*Vancouver News-Advertiser.*

THE BURT WOODEN RAILWAY, CALIFORNIA.

Solidified Petroleum.

The method of making fuel bricks of crude petroleum adopted by Engineer Maestracci, of the Italian navy, is given as follows by the *Revue Scientifique:* The bricks are of similar form and size to the coal briquettes extensively used in France and Germany. The mixture is made in the proportion of 1 liter of petroleum, 10 per cent of resin, 150 grammes of powdered soap and 383 grammes of caustic soda. The mixture is heated and stirred at the same time; solidification begins in about 10 minutes, and the operation must then be carefully watched. If there is a tendency to remain liquid, a little more soda is added. The mixture is stirred until the mass becomes nearly solid. The thick paste is then poured into the moulds, which are placed for 10 or 15 minutes in a drying stove. The briquettes are then cooled and are ready for use in a few hours.

Signor Maestracci recommends the addition of 20 per cent of wood sawdust and 20 per cent of clay or sand, which will make the briquettes cheaper and more solid. In trials made at Marseilles on several tugboats the petroleum briquettes furnished about three times as much heat as coal briquettes of the same size. They were burned in the ordinary boiler furnace without any special preparation, and gave out very little smoke, leaving also little or no ash. The advantages claimed for the petroleum briquettes for marine use are the absence of smoke and a large reduction in bulk of fuel which must be carried as compared with coal, while the risks attending the carrying of liquid fuel are avoided.

Clarification of Sorghum Juice.

Analysis shows that the difficulty in securing a good yield of sorghum sugar is not caused by a deficiency of sugar in the juice, for it is now easy to produce sorghum cane which has, as a general average, 12 to 14 per cent. of crystallizable sugar in the juice. Sugar canes and sugar beets whose juice contains no more sugar give satisfactory yields.

The difficulty in sorghum manufacture is not in the excessive cost of cane which contains 12 to 14 per cent of sugar, for such cane is produced with much less labor in planting, cultivation or harvesting than sugar cane or beets having the same percentage of sugar.

The difficulty is caused by imperfect separation of impurities which are peculiar to sorghum juice, and it follows that when a good clarification can be had the difficulty will vanish.

There are impurities in sorghum juice which can be removed best by cold clarification. Starch is found in considerable quantity in sorghum juice, and gummy and slimy substances which are, perhaps, derived from the shell or joints of the cane. These impurities can be removed to a surprising extent by simply allowing them to subside in the cold, limed juice. If the raw juice is heated, these impurities dissolve in the juice and cannot then be removed.

There are also impurities in sorghum juice which are soluble in the raw juice, but which become insoluble when the juice is heated. These form scums and sediment, and can be removed best by hot clarification.

It appears that a much better clarification of sorghum juice can be had by performing a double clarification, by liming cold juice, settling the impurities and decanting the juice, by heating the partially clarified juice, adding phosphoric acid, again settling the impurities and again decanting the juice.

This method has been used in Kansas for two seasons. With unstripped cane, that is leaves and cane milled together, and with open steam evaporators or with fire pans, it has given brighter and better sirup, with higher purity, than has yet been had in sorghum diffusion sugar houses.

In these days, when the tendency is distinctly toward larger and yet larger sugar houses, it may seem absurd to mention small mills, but the sorghum industry is obviously compelled to study all means for advance. The conditions in Kansas are not altogether the same as those in other sugar-producing countries. That State has a scattered population, too distant from sugar factories to be benefited by them, the greater number engaged in agriculture, owning land and stock, preferring to labor at home, willing to work harder, more hours, and more cheaply for themselves than for others. It is quite possible that they can grow cane cheaply and utilize the seed, and manufacture the cane in small mills and make considerable quantities of crude sugar and molasses for their own use, and it is not impossible that sirup produced in many little mills may increase the outturn of sugar from complete sugar houses.—*The Louisiana Planter.*

The New Railway Tunnel Opposite New York.

Remarkably good work in hard rock tunnel driving is now being done on the Palisades tunnel of the New York, Susquehanna & Western Railroad, near New York. This work has been under way about a year, and it is expected that the tunnel will be completed early in 1894. During the past month the contractors, Messrs. Broadhead & Hickey, drove on the east end of the tunnel, which is in charge of Mr. P. F. McLaughlin, 161 feet of heading and 186 feet of bench, all double track tunnel, dimensions 27 feet by 21 feet. The record in the heading is especially remarkable, owing to the fact that the work was done by night shift only, that is only one shift in twenty-four hours. This plan was first introduced by Mr. McLaughlin, and has proved so successful that it has since been adopted elsewhere. One of the main advantages of the single shift is that, after the drilling and firing, which takes place early in the morning, common muckers are put to work in the heading to get rid of the broken stone, and the man in charge of these muckers sees that the columns are put up and the drills in place for the runners to begin drill work again on the following night. The rock encountered is the well known Jersey trap, known to be one of the hardest rocks in existence. This good work has been done with four Ingersoll-Sergeant F-2 drills in the heading and six on the bench.

Election of a New President in Switzerland.

The new president of Switzerland, recently elected, is Emil Frey, who emigrated to this country, and in 1861 was a farm hand in Illinois. When the war broke out he enlisted as a private in the Union army, and faithfully served until the close of hostilities, having participated in several of the principal battles, and endured imprisonment in Libby and other Southern prisons. After the war he returned to Switzerland, where his excellent education, vigorous and useful career as a journalist, soon brought him to the front among the public men of his country, and now he has received the high honor of election to the presidency.

RECENTLY PATENTED INVENTIONS.

Engineering.

BRIDGE CONSTRUCTION.—Bernard M. Kash, Joplin, Mo. This inventor has provided a method of constructing supports for bridges, consisting of lowering into the water a pile made up of sections, driving the pile into the bed, lowering an anchor over the pile, locking it to an engagement with the bed and with the pile, and driving the anchor to a firm seat in its bed. This foundation may be erected in a quick, convenient and durable manner in deep water, and made capable of upholding a pier.

Railway Appliances.

TRAIN PIPE COUPLING.—Zachariah F. Lightner, Darby, Pa. This invention is intended to provide a coupling for air brake or other train pipes so that the connection may be made without the necessity of going between the cars. A coupling pipe is placed in the coupling head of one of the cars, and this coupling is arranged so as to engage in the coupling head of another car. The momentum of the approaching car causes a bumping of the heads, which are yieldingly mounted so that the parts are not broken, but still the connection between the pipes will be made. Connection between the train pipe and the coupling is made by means of hose.

ELEVATED RAILWAY BRAKE.—Watson L. Reynolds, Jersey City, N. J. The brake shoes, according to this invention, are arranged in pairs, pivotally supported from a common rock shaft and spaced apart to embrace a track rail, with means for rocking the shaft, the rocking of the brake shoe shaft serving to apply and release the brakes. A plate spring bears by its ends on the back of the shoe, affording an improved gripping action on the track rails.

CINDER AND DUST BLIND.—George W. Bohde, New York City. This is a readily applied device, inexpensive, and adapted to fold up in very small compass when desired, or to project outward to any necessary distance to form a perfect shield for the window. It comprises a longitudinally recessed post, a recessed stile, and slats pivoted in the recesses of the stile and post and adapted to lie in such recesses, there being a fastening device to hold the stile and post together.

BRAKE ROD FORK.—George W. Kelly, Marquette, Michigan. This improvement is especially adapted for use in connection with the brake rods of railway or street cars. The fork and a tem are passed through body of the fork and headed between the tines. When the fork or jaw is to be used in connection with the top and bottom brake rods, the shank may be held in the fork by means of a rivet.

Mechanical.

WAGON TONGUE SUPPORT.—John F. Tiner, Sutherland Springs, Texas. This novel device consists of a transverse shaft around which a torsion spring is coiled; at either end of the spring is a ratchet wheel connected to the tongue of the wagon. The spring has a tendency to hold up the tongue through the medium of the chain and wheels. This invention does not interfere with the ordinary running gear and takes away considerable of the friction.

GATE.—Jacob E. Knapp, Brownsville, Oregon. The object of this invention is to provide a gate swinging from its center through the manipulation of levers. The gate is lifted vertically at the same time it swings open. After the person has passed through the other lever is depressed and the gate swings back to its normal position. The mechanism can be applied to either a single or double gate.

MOTOR FOR CLOCKS.—Sigismund B. Wortmann, of New York City. This invention is a motor of the gravity type, adapted for the propulsion of clock mechanism without employing the aid of springs, spring drums or like factors. Motion is imparted to the master gear by means of a weighted lever secured to the shaft of the master wheel.

WAGON JACK.—John F. McDaniel, Syracuse, Kan. The object of this invention is to provide a simple durable wagon jack capable of convenient manipulation. A feature of the invention is a locking device for the lifting lever, which will act automatically to hold the lifting bar of the jack in whatever position it may be placed, and further to provide a means whereby the locking device may be readily disengaged from the lift lever whenever required.

LAND ROLLER.—David A. Grant, Raleigh, Canada. This invention relates to an improvement in land rollers by which a number of rollers may be coupled together and used as one, the rollers having a common frame. The roller may be used on rough or undulating ground and is also provided with scrapers for the various rollers, the scraper of each set being capable of independent manipulation, the driver of the roller being able to bring all the scrapers into requisition or any one of them, as occasion may demand.

CHUCK FOR SCREW MACHINES.—Edwin E. Saum and Frederick E. Blackman, Stamford, Conn. This is a chuck more especially designed for use in connection with milling machines, to conveniently and rapidly mill pins, screws, etc. The construction is such that the articles to be operated on can be placed very close together, so as to make the cut formed by the cutter practically continuous. The device is very simple and durable in construction.

SPRING LOCKING NUT.—Charles P. Dorr, Ellsworth, Me. This nut has a thickened central body adapted to receive a bolt and reduced spring arms thereon extending laterally and returned on themselves, the returned members extending beyond the plane of one face of the nut. The spring arms are adapted to press against an object through which the bolt of the nut extends, so as to take up all slack and prevent the nut from getting loose.

LIFTING JACK.—Charles W. Ball, Commerce, Texas. This is a wagon jack of simple and durable construction, and one which permits of conveniently raising the rear or front axle without shifting the hoisting lever in the post.

Electrical.

PAPER HOLDER.—William P. Stibbs, Belleville, N. J. The object of this invention is to provide a paper holder adapted to receive papers or small parcels. When the holder is raised slightly and the paper or parcel is about to be inserted, an alarm is sounded by an electric bell connected with the holder. When the arm of the holder is raised sufficiently to allow of the insertion of the paper, the contact is broken and the alarm ceases. Thus the persons in the house are notified when the paper or package is inserted. When it is removed the same action takes place, the bell ringing just before the holder reaches the normal position.

TELEPHONE INVENTIONS.—Eloy Noriega, Mexico, Mex. The first invention is a microphonic telephone transmitter, designed to be used in connection with heavy currents with especial view to working over long distances. It is constructed so that it will remain in adjustment and work uniformly under all conditions. The primary circuit is through carbon bars attached to the diaphragm, and through a series of loose carbon bars having ends reduced in diameter, entering cavities in the bars attached to the diaphragm. These bars are pressed by a spring through the medium of a body of absorbent elastic material. The carbon electrodes used in this instrument are made of a new compound of charcoal, coke, and boric acid—sometimes with the addition of graphite. The second invention is also a transmitter, in which the carbon electrodes are held in contact by the action of a magnet, thus securing a delicate adjustment of the carbons and a more effective action. In this instrument the diaphragm carries two perforated blocks in which are inserted carbon cylinders provided with soft iron armatures. A permanent magnet located near these armatures holds the carbon cylinders in electrical contract with the carbon blocks carried by the diaphragm.

AUTOMATIC TELEPHONE EXCHANGE SYSTEM.—John Serdinko, New Braunfels, Texas. Combined with a number of sending instruments adapted to send positive and negative impulses, a central registering device for each instrument, are a switch, a magnet and a vibrating lever, other novel features of arrangement enabling the instruments to be connected by a single wire, dispensing with the use of an operator at the central station. Automatic means are also provided for registering the messages sent by each subscriber, with an automatic switching device by means of which one subscriber may connect with any other.

SUPPORT FOR TROLLEY WIRE.—James R. Walker, Denver, Col. This support is formed of a longitudinally grooved casting furnished with a screw-threaded socket for attachment to the insulator, and a removable clamping piece attached to the main piece by means of screws. This support can be easily and quickly applied without the use of solder, thereby prolonging the life of the trolley wire, and it is smooth and noiseless.

Agricultural.

CULTIVATOR.—Andreas Mattijetz, Giddings, Texas. In this machine all the plow shanks are adjustable to or from the center line of the frame in order to adapt the cultivator for working different kinds of plants. The lateral adjustability of the plows upon the standards is also provided for, means being provided for maintaining both the standards and the plows in whatever position they may have been placed. The machine is very light, has an easy draught, and is especially adapted for the cultivation of stump fields.

Miscellaneous.

DUST PAN.—George B. Sarchet, Butte, Montana. The frame of this pan has a depressed circular seat, with an inlet leading to and from the seat, in which turns a receptacle having an opening in one side adapted to register with the inlet or the outlet. The construction is simple and durable, and such a dust pan is adapted to readily gather up and retain the sweepings in the pan until it is convenient to discharge them.

SHOW CASE.—Gustave J. Meyer, St. Louis, Mo. This case has sectional glass walls, with a glass door in each section, there being also horizontal partitions secured to the case walls between the sections to form compartments located one above the other. The case is preferably made in pyramidal form, the compartments increasing in size toward the top, and in its hollow base is a drawer.

SHOE FASTENING.—Henry Vachon, Golden, Canada. This is a lace fastening comprising hooks along the edges of the fly, a tongue separate at its edges from and covering the fly and provided on its under side with a central longitudinal series of parallel transverse hooks, each hook comprising oppositely facing parallel members, while the lacing is rove back and forth through the fly and tongue hooks. Each hook is formed of a single piece of wire and has a spring hook. The fastening is quickly made to secure the shoe to the foot, and gives a nice fit over the instep.

HOOK AND EYE.—John D. R. Lamson, Toledo, Ohio. The hook, according to this improvement, has its inturned end adapted to form a snap, and the eye has its end or bow made larger than its sides, the bow being slightly larger and the side slightly smaller in the direction of the plane of the bow than the opening into the hook, whereby the bow of the eye may be snapped into the hook, and its side may be slipped out when the side is turned to position to escape below the point of the hook.

WIRE FENCE.—Oscar C. and Pierse B. Moreland, Henderson, Ky. An economical tie or binder for the several strands of a fence is provided by these inventors, consisting of a single piece of wire having its opposite ends secured to a common strand of the fence by twisting, the portions near the ends being carried beyond the strands on opposite sides and passed rearwardly over, while the middle portion is passed in front of the common strand.

HOOF WEIGHT.—William Hamilton, Bedford, Iowa. This invention provides a toe or side weight which will adjust itself to the inclination of the hoof to which it is applied, and be self-locking, while it is of simple, durable, and inexpensive construction. In using this improvement a comparatively small portion only of the hoof need be removed, and there is no possibility of the weight leaving the hoof.

FORCEPS.—Michael McNalley, St. Louis, Mo. This is an improvement in implements utilized in veterinary practice for withdrawing teeth of animals, or cutting or trimming them. The two jaws of the forceps may be gradually and equally drawn together to produce a cutting action when required, or they may be quickly closed to effectively clamp the teeth. The implement is very light and easily handled.

LAMP CHIMNEY CLEANER.—Mary F. Hotham, Hillside, Pa. Secured to a handle are two or more U shaped fabric-retaining bars, which are secured at their upper ends by a movable collar. To these retaining bars, pieces of movable cleaning fabric are fastened and new pieces can be easily inserted when they are worn out by disengaging the collar and removing the bars.

CINDER SHOVEL.—Samuel J. Besthoff, New York City. This invention consists of a shovel having U shaped tines composed of wire or metal rods and is adapted to remove cinders from grates, etc. The shovel, by reason of its novel construction, receives the coal and cinders, allowing the dust and ashes to drop from the shovel, leaving the coal and ashes therein and in condition to be assorted if desired.

SIPHON MOTOR.—Frederic Wm. Reinhardt, Memphis, Tenn. This motor is adapted for furnishing small power. The motive power is derived from an overshot water wheel placed in an enlargement of the outlet leg of the siphon. As the water passes from the inlet leg through the outlet leg it causes the wheel to revolve and impart motion to a pump or other piece of machinery.

WATCH BALANCE.—George H. Smith, Lancaster, Ohio. This improvement provides an attachment for balance wheels whereby the rate of vibration will be changed without shifting the screws in the balance. The balance has longitudinally slotted arms in which are placed sliding weights, screws passing through the slots and through holes in the weights to shift the weights along the slots. The changing of the rate of the watch may thus be effected by moving the weights, doing away with the usual method of adjustment by changing the screws in the rim.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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Minerals sent for examination should be distinctly marked or labeled.

(5577) J. C. A. asks: 1. What makes the draught in a chimney, and why has a tall one more draught than a short one? A. The difference in the weight or specific gravity of the hot air inside and the cold air outside makes the chimney draw. This is readily illustrated in observing the upward flow of hot air currents around a stovepipe or the ascent of fire balloons. The higher chimney, having the greater volume of heated air and gases, has the stronger draught. 2. A says that a sounding lead will not sink beyond a certain depth, owing to the compression of the water. B says it will sink to the bottom, whatever the depth. Which is right? A. B is correct. Everything that will sink at moderate depths will go to the bottom of the deepest oceans.

(5578) J. E. P. asks for a receipt for case-hardening that will harden about one thirty-second of an inch thick for bicycle bearings. A. Pack the articles to be case-hardened in an iron box or piece of iron pipe with hoof shavings that have been charred and pulverized. Heat at a low red for half an hour or more, then raise to a cherry red and plunge the articles in water.

(5579) L. L. G. and R. S. H. ask: Why is not length a speed factor in steam vessels as well as in sailing vessels? Take for instance the Fulcsen and the new cruiser Columbia, both built for speed. Take also the yachts Queen Mab and Valkyrie, built also for speed. As it is possible for the Fulcsen to develop as much speed as the Columbia, why is it not possible for the Queen Mab to develop as much as the Valkyrie? A. Length is a speed factor, as it enables greater power to be carried in proportion to the midship area in steam vessels and more sail in sailing vessels, as illustrated in the larger four masted clippers and schooners. In both classes of vessels the conditions of relative dimensions and power are hampered by the required duty other than speed, and with racing yachts length is regulated by yachting rules. The models are now so nearly perfect that for matched boats the difference in speed may be entirely due to excentricities of the wind.

(5580) R. F. C. writes: 1. Is there any means by which I can produce a thin stream of electric light between two points about one-half inch apart, the light to be steady (not like the spark of an induction coil) with an intense heating power; it is the heat that I wish to use. Also is it impossible for me to use it if it is produced in a vacuum? A. You can do this with the arc. The Bernardos system of welding utilizes the arc as a heating appliance. For this see our SUPPLEMENT, No. 840. We have others on electric welding by other processes. 2. Does the arc light produce an intense heat? A. It produces about the most intense heat that can be produced by man. 3. I built a small direct current, 20 lamp, 16 candle power, 52 volt dynamo, which we have used some time; several days ago one of the leaves of

copper that the brushes are composed of dropped down and touched the bed of the machine, there was an intense flash of fire and all the lights went out. What was the cause? Was the machine short-circuited or not? A. It is undoubtedly a case of short-circuiting. The piece of copper must have connected the two terminals in some way. Possibly its brush was connected to the other terminal; possibly the field is in contact with a bare spot of its winding.

(5581) E. C. B. says: I have a damaged mirror and want to cover up several blotches. Can you give me directions for doing it? A. Remove the silvering from the glass around the scratch, so that the clear space will be about a quarter of an inch wide. Thoroughly clean the clear space with a clean cloth and alcohol. Near the edge of a broken piece of looking glass mark out a piece of silvering a little larger than the clear space on the mirror to be repaired. Now place a very minute drop of mercury on the center of the patch and allow it to remain for a few minutes, clear away the silvering around the patch, and slide the latter from the glass. Place it over the clear spot on the mirror, and gently press it down with a tuft of cotton. This is a difficult operation, and we would advise a little practice before trying it on a large mirror.

(5582) J. B. J. asks: Is vaccination hereditary, so as to render it unnecessary for a descendant of a person who has been vaccinated to be vaccinated? When did vaccination first originate? Does vaccination undermine the physical condition or reduce the average length of life of mankind? A. Vaccination is not hereditary, nor is it safe for the person vaccinated for a longer period than seven years. It seems to have no effect upon human vitality either to shorten or lengthen life. It was discovered by Dr. Jenner more than 100 years ago. See an interesting account of its discovery and early history in SCIENTIFIC AMERICAN SUPPLEMENT, No. 709.

(5583) A. V. E. B. writes: In the recent International race the English claim that a boat built to race for the America cup, in so far as it has a transatlantic voyage to make, cannot be a mere racing machine. Would you please state if, in your judgment, this is a factor worth considering in deciding about the relative merits of the racing boats of the two countries or of the two kinds of boats—keel and centerboard? Do you consider it necessary, as naval architects on the other side hold, that in designing a boat to contest for the cup any departures should be made that would materially interfere with fast sailing? A. It is well known by naval architects and expert builders of racing yachts that all the American contestants in the international races have been as good sea boats as their adversaries, and not merely racing machines. If ever the cup goes back to England, it will find the centerboard racers equal to the voyage for a contest on the English seas.

(5584) A. K. writes: I wish to light a one candle power incandescent lamp at intervals which will not aggregate more than twenty minutes per day. Can you name an inexpensive non-freezable battery for operating same, one that will remain charged for a considerable length of time? A. We advise you to use a dry battery. One or two cells should suffice.

(5585) T. J. P. asks in what manner a gold chain that has been dropped into the fire and burned black can be restored to its original color. A. Heat in dilute nitric acid until the desired color is reached. Possibly immersion in ammonia water will answer.

(5586) W. H. R. asks for a preparation which can be applied to tan shoes to render them waterproof without changing the color. A. Beeswax, 1 part; oil of turpentine, 4 parts. Apply with a cloth and polish with Canton flannel.

(5587) H. R. T. asks: When was the triple propeller first attached to vessels? A. Triple screws have been in use in a few naval vessels of France, Germany, and Italy, for several years. See articles on triple screws and the trial of the Columbia in SCIENTIFIC AMERICAN SUPPLEMENT, No. 935, 10 cents mailed.

(5588) S. B. W. asks: What per cent of the energy in the steam engine or other running power is changed into electricity by the most improved dynamo? A. Ninety per cent of the indicated power of the engine is claimed to be the energy of the electric current in horse power. And if again transformed into effective power by a motor, the resulting effect is claimed to be 81 per cent.

(5589) V. S. W. says: We have recently built a small standpipe, 10 feet by 60 feet, for water supply and fire protection. We use each week day about 15 feet of water and replace it with water from our deep well, which has a temperature about 50° Fah. Shall we be troubled by its freezing, and is it liable to be damaged by ice? It is entirely exposed to the weather. Pipe connections are all from the bottom. A. The standpipe should have a close roof to keep the surface of the water from freezing over and accumulating ice, otherwise no protection is needed except the pipe connections.

(5590) I. I. asks how curling stones are dished out and made true and polished. Also if such work is done in the United States. I understand they must all be sent to Scotland. A. Curling stones are blocked out by chiseling in the ordinary method of stone cutting, then finished and polished in a stone turning lathe. Any granite worker having a lathe can make them.

(5591) W. J. writes: 1. I have a glass cylinder, which I wish to make into a friction machine, but cannot find out how to drill the holes in the ends. How can I do this in good shape? A. These can be drilled with a file held in a carpenter's brace. Break off the end, so as to give a sort of drill point. Lubricate with turpentine and camphor. Or cement a cork where the hole is to be, and drill the hole with a copper tube, centered by the cork, and fed with oil and emery. Turn with a brace. 2. Can you tell me how much the castings for Perretts' small dynamo will cost me? A. If you make your own model, they should cost from 5 to 10 cents a pound.

(5592) A. N.—Theoretically there is no difference between the power of a crank and an eccentric of equal throw. Practically the eccentric is subject to greater friction than a crank pin and hence less efficient.

(5593) T. T.—The brass wire cloth can be cleaned by scrubbing with a brush, using a solution of 2 ounces oxalic acid to 1 quart water, and powder of Bath brick or pulverized pumice stone with the solution.

(5594) F. D. H. asks for a method of computing the length of a degree of longitude at any point on the earth's surface, for instance on the Tropic of Cancer or the Arctic Circle. A. Multiply the length of a degree at the equator by the cosine of the required latitude; thus, cosine of the latitude of the tropics 23° 27′ is 0·91741 and 69 × 0·91741 = 55·0446, or 55 miles 235.476 feet.

(5595) R. B. S. asks rule for casting lead sponge used in those storage batteries described in SCIENTIFIC AMERICAN, No. 21, November 18, 1893. A. Keep stirring the lead until it is on the point of solidifying; then cast it in blocks and saw up into plates.

(5596) A. R. T. asks: 1. What size should the plates of a storage battery (two cells) described in the SCIENTIFIC AMERICAN some months ago, and how many to run small motor, one-sixteenth horse power, continually for about four hours, storage cells to be charged by six cells of gravity battery? A. Provide at least two square feet of positive plate in each cell. Arrange size of plate and number to suit yourself. 2. How often would gravity battery have to be recharged if cells were connected to the storage cells all the time except when using? A. About one-tenth ampere current would be taken, which would set free about two grains of metallic copper per hour, so that the batteries would run many days, except for local action. 3. What acid can the plates be placed in to roughen them sufficiently for the application of the red lead? A. Nitric acid diluted 1 acid to 5 water.

(5597) O. C. R. asks: What chemical solution could be used to write on a "blue print" with a perfect white line? Caustic soda will dissolve the blue, but the yellow tint of the iron remains in the mark. I was given a solution which produces a perfect white line. It is neither acid nor alkaline. The flame test produces the violet color of potash, and silver nitrate solution forms a white precipitate, which is soluble in dilute nitric acid. Can you give me any information as to what this solution may be? A. Probably binoxalate of potassium dissolved in water to the strength of 1 ounce of the salt to 4 of water.

(5598) A. L. W. says: 1. The film that I use in my camera bothers me badly, on account of its tendency to curl up very tightly when I wish to print. Please give formula to prevent this curling, and also a cement or glue that will stick the film to glass. A. There is no good remedy for curling. One is to soak the films in a mixture of one-eighth glycerine and seven-eighths water after washing, for a few minutes. After drying the films should be packed flat between stiff cardboards. We think ordinary fresh glue, such as Le Page's or Chase's, will answer to fasten film at its edges to glass. 2. What is the value of the silver on a single-plated teaspoon? A. Perhaps three cents. Depends on how thick the single coating is.

(5599) T. R. E. asks: 1. How is a Leyden jar made, and what is it good for? A. It usually is a glass jar covered for about three-fourths of its height, inside and out, with tin foil. For special purposes, other constructions are used. It is used to store electricity of very high tension, so as to give shocks and sudden discharges, and is used in much experimental work. 2. I hear of an Ideal storage battery that will run a phonograph over one hundred hours. I wish to run a lamp one hour at a time, three times a week. A. Allow two volts for each couple in the battery, and buy a lamp of the voltage thus obtained. 3. How many candle power lamp shall I get? A. For two couples you can use a one candle power lamp, for three couples a two candle power lamp. 4. Can I charge the storage with ten cells of telegraph battery which I have, as I live a long way from an electric light plant? A. The ten cell telegraph battery will charge three couples. 5. How shall I connect them? The posts are marked P. N. A. Arrange in series and connect the copper plate terminal of the telegraph battery to the terminal of the red colored plate (marked P.) and the other terminal of the telegraph battery to the gray plate terminals (marked N.) Go by the color of the plates rather than by the letters.

(5600) H. E. W. B. asks: 1. How can I mix sodium with chloride of gold for gilding solutions? A. We presume you refer to the double chloride. It is made by dissolving 58·5 parts sodium chloride and 303·7 parts gold chloride in water. By evaporation the double salt is obtained. 2. What effect has alum when mixed with saltpeter, common salt, and muriatic acid for coloring gold? A. It is hard to give a chemical reason. Alum is very acid in tendency, the acid having rather slight affinity for the base, and in a certain sense it represents an acid in its action. 3. What flux should I use when gold is brittle, so as to make it roll good? Also is there any way to prevent blowholes in casting gold? A. Melt with borax and sodium or potassium nitrate. Possibly annealing is all that is required. 4. Is bisulphide of tin the same as tin bronze? A. Tin bisulphide is often used as a bronze powder, under the name of mosaic gold. Bronze powder is often made by secret processes. 5. How is the vacuum made in the incandescent lamp? Also how can I carbonize silk for lamp? A. The vacuum is made by air pump. Carbonize filaments by embedding in charcoal dust, placing in an iron case and heating to redness. For pumps see our SUPPLEMENT, Nos. 284, 569, 629, 630, 681, 771. 6. Can more than two messages be sent over the same wire at once? If so, how is it done? A. Yes. The apparatus is described in the books such as Prescott's "Electric Telegraph," 2 vols., price $7; Maver's "American Telegraph," price $5; Thorn and Jones' "Telegraphic Connections," price $1.50. 7. How should pneumatic tires be kept through the winter so as to keep them from honeycombing? A. No special treatment is required. They should not honeycomb if they are of good quality.

(5601) M. McN. asks: What is the relative strength of cast steel forged or cast steel castings? Does the addition of aluminum to castings make the steel harder or not? Can the steel be cast as thin as iron? A. The strongest cast steel forgings, as usually made, have a tensile breaking strength of from 125 to 150 thousand pounds per square inch. Castings of steel have a very variable range of tensile strength, according to shape and size, from 40 to 60 thousand pounds per square inch. The addition of a small percentage of aluminum to low carbon steel for hammer working makes a tougher and stronger metal, which may vary in tensile strength from 140 to 175 thousand pounds per square inch. With steel castings, a small percentage of aluminum largely increases their strength and solidity, with possibilities of over 80 thousand pounds per square inch.

(5602) R. F., Decatur, Ill., writes: Our city has put in a filtering plant at the water works, locating it on a hill, some 75 feet above the pumping station. We have a pumping engine to take the water from the river to the filter, from which it runs into a reservoir of nearly same height, and from there through about 500 feet of 16 inch pipe down to another engine at same station, by which it is pumped directly into the city mains, under an ordinary pressure of about 75 to 80 pounds per square inch, but which is brought up to nearly 100 pounds when needed for extinguishing fire. The pipe which brings the water down from reservoir (suction pipe, we will call it) was connected directly to the main pump and under ordinary service stood all right, but when fire pressure was put on this pipe broke by "water hammer." It is an ordinary cast iron pipe, 16 inches diameter and seven-sixteenths inch thick. A controversy has arisen between some of our local amateur engineers as to the best way out of the difficulty. One party, which we will call A, says this hammer is irresistible and cannot be overcome, except by letting the water out into a well or cistern at the bottom of the hill, to be pumped from there into the mains, or else by putting the main pump on the hill by the reservoir. The first of these all admit would be a great waste of power, to be tolerated only as a temporary makeshift, and the other has some objectionable features. Another party, whom we will call B, holds that neither of these plans is necessary. That as the water in the suction pipe has a free passage through the pump into the mains at all times (excepting the slight obstruction caused by the necessity of raising the valves), the pressure in the suction pipe can never be more than very slightly greater than that in the main pipes, and all that is necessary to overcome the liability of breakage is to make this suction pipe strong enough to safely stand the highest pressure that is ever put on the main pipes. He holds that this ramming action is really an advantage, as tending to give a steadier flow of water into the mains by continuing the flow while the pump is changing strokes. He holds also that as a water hammer without an outlet is conceded to be almost irresistible, the fact that this pipe stood while the pump was working against ordinary pressure proves conclusively that there is an outlet, which he claims is sufficient to substantiate his theory that the suction pipe is simply too weak to stand the pressure which the water in it has to act against in the mains. Who is right? If neither, please set us right. How thick must a 16 inch cast iron pipe be to stand 100 pounds pressure with a good margin of safety? A. The statements of all parties are correct as far as they go, barring the accidents from a water hammer, which is so uncertain in its effect that its transmission through the pump to the force main is a dangerous expedient. A 16 inch pipe to be safe at 100 pounds pressure should be ¾ inch thick. Such a pipe for your suction would be very expensive, as the normal pressure in the suction pipe is only 33 pounds per square inch. We advise large air chambers on both suction and force mains, as near the pump as possible, with an independent air pump to keep them charged with air at all times. There can be no water hammer under this arrangement. The main pump could be made the source of power for the air pump by a side rod and bell crank lever, which can operate a small air piston, single acting, of sufficient capacity to supply the amount of air absorbed by the water in the air chambers. The air pipes should be connected at the bottom of the air chambers with a check valve in the high pressure air pipe and a stop valve in the low pressure side leading to the suction air chamber, so as to control the air in either direction.

(5603) C. H. C. C. asks how to produce the black bronze on brass and iron. A. The black bronze on brass may be made by immersion in a solution of 10 ounces muriate of arsenic, 2 pints permuriate of iron, 1 pint water. For black bronze on iron by immersion or brush:

Bismuth chloride	1 part.
Mercury bichloride	2 "
Copper chloride	1 "
Hydrochloric acid	6 "
Alcohol	5 "
Water	50 "

By weight.

Let the liquid dry on the article and immerse in boiling water for a half hour and dry.

(5604) J. G. B. asks: Will you be kind enough to tell me how to rid our premises of these bugs. I know of other houses and whole blocks of buildings so infested that people are at their wits' ends to know how to rid themselves of them as we are. Borax will do to put on pantry shelves, etc., but I need something to cover the whole kitchen and pantry and dining room floor at night when they come out, and to keep it there; the remedy would be about as bad as the disease. They really are a very great nuisance. Answer by Professor Riley: The insects sent were specimens of the common Croton bug or German cockroach (*Phyllodromia germanica*). The main difficulty in ridding houses of this pest is due to the fact that people do not seem to be willing to take enough trouble. They wish something which they can scatter about once and be relieved for all time, but, unfortunately, there is nothing which will accomplish the result in this easy way. There is nothing better in my experience than to thoroughly and persistently use California buhach, a home-grown pyrethrum powder. This should be puffed from a small bellows into all cracks or holes and crevices in the infested room just after nightfall and the room should then be closed and left until the following morning. In the morning the servant should go over the room with a broom and sweep up every specimen found upon the floor and burn them. This process should be repeated for two or three nights in succession, and at the end of that time the trouble will be mainly past. The insects breed rapidly and migrate from one house to another, so that the operation will probably have to be repeated again after some months.

(5605) J. H. M. writes: 1. I wish to run three or four 16 candle power incandescent lamps, for about two hours each evening. What kind of resistance lamps would be the best, and how many and what style of storage batteries would be the most efficient and yet be cheaply and easily made by an amateur? How many gravity batteries would be necessary to charge the storage batteries, charging for 10 to 15 hours daily? A. Special low resistance lamps are made for this purpose. By all means buy your battery. For charging you may allow from ten gravity cells upward for each cell of storage. 2. I have a Dr. Gassner dry battery that is played out. Is there anything that I can put in it to make it work? A. Sometimes water will get a little more out of an exhausted dry battery. 3. What is the diameter of a core used in an induction coil 6 inches long? A. About ¾ inch. 4. Would double cotton-covered wire used for secondary coil be as good as double silk-covered wire? A. It would probably be a little greater in diameter and hence not quite as good. 5. How much No. 36 wire would be necessary for a coil of the above size? A. No quantity can be prescribed. See our SUPPLEMENT, No. 160, for the construction of an induction coil.

(5606) J. M. L., Jr., asks: 1. How may I make a good but inexpensive lacquer for nickel, silver, and copper after plating? A. Use alcoholic solution of shellac or seed lac. The great point is to apply it properly to the absolutely clean metal previously warmed. A finger touch will impair the success of the operation. 2. It is said that the plating solutions will soak through earthenware after awhile. Could you give a preparation to prevent this? A. Try melting in paraffine, the wood being absolutely dry. 3. About how manny gallons of nickel solution could I run with a current of 15 amperes and 5 or 6 volts? A. There is no question of quantity of solution. Allow at starting 0·1 ampere at 5 volts per square inch of cathode, and then reduce to 0·02, ampere at 3 volts per square inch.

(5607) E. B. T. asks: 1. What is the chemical reaction of the caustic potash battery? A. The zinc oxidizes and dissolves in the caustic potash solution. 2. Can it be recharged by reversing the current through it? A. Yes, but it hardly pays. If it was a Lalande-Chaperon combination, you would probably fail in oxidizing the copper depolarizer. 3. Have you ever published an article on running a dynamo by windmill power? If so, in what number? A. See the SCIENTIFIC AMERICAN, vol. 63, No. 25. 4. Also the automatic regulation of a dynamo for an unsteady source of power. A. You must regulate your power. 5. What are the requisites of a loud-speaking telephone of the bell type? A. The Edison loud-speaking telephone depends on a distinct principle, the change of coefficient of friction by electrolysis.

(5608) L. C. T. asks: I have six or eight ounces of No. 36 bare copper wire, the insulation having been burned off by an overcharge. I wish to use it on an induction coil. Would the burning of the insulation affect the quality of the wire in any way? Can you tell me how to construct a coil, using the bare wire for the secondary coil? A. If your wire is not divided, it can be used. Test it first with a battery and galvanometer. For induction coils we refer you to our SUPPLEMENT, Nos. 160, 229, 569. 2. How could I manufacture ice on a small scale with the least apparatus possible? A. This cannot be done economically. Small ice-making machines are sold for the purpose. Address Queen & Co., Philadelphia, Pa. 3. In charging storage batteries by wind power, the windmill would not always be running at the same speed; would this make any difference in charging? A. You must have an arrangement for disconnecting the battery when the mill runs too slow. Binders for the SCIENTIFIC AMERICAN or SUPPLEMENT are $1.50 each prepaid by mail.

(5609) P. L. A. writes: To make artificial ice right in the ice house when the weather is cold enough, would it do to use a hose from the hydrant, and make a sprinkler in the ice house, so that when the water is turned on, all surfaces will receive an even thickness for freezing? Then when the desired thickness for a cake has been obtained, and this thickness having frozen solid, what should be used to separate the first layer of ice from the second? Would it be well to use waterproof building paper which has not been tarred? We have a large ice house which we will fill in something like this way if it is possible to do so. The weather is generally cold enough for a long period to allow the water to freeze solid before being bothered with a thaw. A. The filling of the ice house in the manner described is feasible on a small scale where the winter cold is nearly continuous. The only inconvenience will be in cutting out the ice in summer, as in freezing the walls of the ice house become solid, which prevents drainage from the hollow central cutting. Means would have to be provided to clear the surface water. We apprehend that the paper will not favor the cleavage of the ice; the water will soak the paper and by freezing make its separation uncertain.

(5610) E. O. B. asks (1) how to make the best composition with which to fill honey-combed shaped lead plates for a storage battery. A. Use red lead for the positive and litharge for the negative plates. Mix to a paste with dilute sulphuric acid. 2. How to make a solution for the same? A. Use dilute sulphuric acid, 1·170 sp. gr. 3. How to ascertain the maximum charging current for the same? A. Charge at 5·3 amperes per square foot of positive plate. 4. How to know when the battery is fully charged? A. Charge until the cell boils, *i. e.*, evolves gas copiously. The acid should rise to 1·20 sp. gr.

(5611) O. C. asks: 1. What book or publication gives the most complete description of the best methods of making permanent steel magnets, kind of steel, best temper, shape and proportions to get the greatest attractive force, current to use in charging them, etc.? A. Silvanus Thompson's work on electromagnets, $1 by mail, contains some information applicable to your subject. For magnetizing use as strong a current and as many turns in the magnetizing coil as will give maximum ampere turns. Use tool steel drawn to a straw color. See also our SUPPLEMENT, No. 318. 2. Can you give a rule by which I can calculate the weight of 1 cubic inch of water

under different pressures? I find it stated that 1 cubic inch of water at 70° Fah. under the ordinary atmospheric pressure weighs 0·578 ounce. What is the weight of same when under a pressure of 75 pounds as indicated by a Crosby water gauge? A. Water is very slightly compressible. For one atmosphere of pressure (14·7 pounds), it is compressed 0·00005 of it original volume. For 75 pounds above the atmosphere therefore it would increase in weight about 0·00095, giving 0·57814 ounce instead of 0·578 ounce. The above rule is approximately correct.

(5612) E. G. R. asks: 1. Will the No. 2 water motor described in SCIENTIFIC AMERICAN of October 14, page 244, run the hand power dynamo described in "Experimental Science"? A. Yes, if there is sufficient head of water. 2. How large a lamp would the above dynamo run when the field magnets are separately excited with six or eight Bunsen cells? A. Three to five six-candle power lamps, without any cells; with the cells twice as many, especially if you use a drum armature. 3. When field magnets are separately excited as above, would the dynamo charge two storage cells? A. Yes. 4. What horse power has the No. 2 water motor? A. Address the manufacturers for particulars.

(5613) F. E. K. asks: 1. Can a plastered wall in a house be blackened so as to be used as a crayon board? If so, how can I prepare a paint to be used to paint it? A. For a wall blackboard: to 1 pint shellac varnish add 6 drachms lampblack, 1 drachm of ultramarine blue, 3 ounces ground pumice stone, 2 ounces rottenstone ground. If not thin enough to spread easily with a brush, add enough alcohol; two or three coats will be needed for a plastered wall. 2. How far is New York City from the deep ocean, and the length of Broadway in the same city? A. About 12 miles in a direct line. Broadway is about 5 miles long. 3. What is the size and weight of the Capstone on Washington monument? A. The capstone of the Washington monument weighs 3,300 pounds. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 476, for an interesting account of its setting. 4. What is the size of the smallest boat that has crossed the Atlantic Ocean? A. About 18 feet in length.

(5614) H. L. B. asks: 1. What is the safe carrying capacity in amperes of a copper wire, No. 14 gauge, B. and S. and how is the carrying capacity of any wire to be found? A. 6·4 amperes. See Sloane's "Arithmetic of Electricity." Allow 2,000 amperes per square inch of section. 2. Is there any book published giving directions for concealed incandescent wiring? A. We can supply Badt or Davis on "Electric Wiring," $1 each by mail. 3. Is there any instrument on the market for recording the height of water in a tank located some distance from the station supplying it? Could not a common low pressure water gauge be used? A. A pressure gauge could be connected to do this.

(5615) A. E. N. writes: In the SCIENTIFIC AMERICAN SUPPLEMENTS already received from you I find a Wimshurst electric machine (glass friction) advised for the generation of ozone by electricity. But having better opportunities to use other sources of electricity, I should like to know: 1. Whether a galvanic battery or a magneto-electric machine could be substituted for the Wimshurst? A. No. 2. What is the strength of a Wimshurst electric machine (taking as a standard the Daniell cell=about 1 volt) compared to other electric machines, viz., 1, Daniell battery; 2, Davis & Kidder magneto-electric machine; 3, Gaiffe's pocket electro-medical machine? A. It may run up into millions of volts. The electro-medical machines probably do not run higher than two or three hundred volts.

(5616) W. F. R. writes: 1. Have you any literature relating to the manufacture of copper oxide plates as used in Edison Lalande battery? A. We have no literature on this. We could supply you with the patents at 25 cents each. 2. Can you inform me as to the best and cheapest method of preparing copper oxide (black)? A. Ignite copper borings to redness in the air. 3. Do you think it would be possible for me to make a box of blackleaf for heating above plates? If so, how should I proceed to prepare such a crucible? A. Use a mixture of clay and plumbago made into a paste with water.

(5617) T. G. S.—The photograph sent by you shows a fresh water lizard, probably *Triton tigrinus*, Green. It is an aquatic species not rare, and well known. The horns you mention are branchial appendages which grow out and are shed. See N. Y. Natural History Survey, Zoology, Fishes and Reptiles, page 83; in illustrations, plate 15, Fig. 32.

(5618) C. C. N. writes: How many storage batteries of a given size would it take to run a 40 horse power motor? How long would it take to charge them with a 10 horse power dynamo, and also a 2 horse power dynamo? How long would it take to discharge them? Also, is the power being used up when not running? A. You may allow 495 cells to run the motor 10 hours. It will take four and a quarter times and twenty-five times the period of running to charge with the 10 horse power and 2 horse power dynamos respectively. It will very slowly lose its charge when not working.

(5619) A. R. K. asks: 1. What do electricians call a multiplier, and in what capacity is it used? A. A galvanometer is sometimes called a multiplier. 2. Is there a multiplier, so called, that can increase the efficiency of a dynamo from 75 to 100 per cent? A. No. This would be in the line of perpetual motion. There is room, however, for inventions in increasing the efficiency of dynamos.

(5620) H. S. S. asks for (1) a recipe for a tin electroplating solution for plating on copper. A. We quote the following from the "Scientific American Cyclopedia of Receipts, Notes, and Queries:" "Deposition of Tin by Simple Immersion or Dipping.—For this purpose a saturated solution of cream of tartar is made with boiling water; in this solution small brass or copper articles, such as brass pins for example, are placed between sheets of grain tin and the liquid is boiled until the desired result is obtained—a beautifully white coating of tin upon the brass or copper surfaces. Ordinary brass pins are coated in this way. A little chloride of tin may be added to the bath to facilitate the whitening. The articles are afterward washed in clean water and brightened by being shaken in a leathern bag with bran." 2. Please describe the machine Nikola Tesla uses to produce high alternating currents. What is its armature made like? A. We refer you to SCIENTIFIC AMERICAN, Nos. 9, 11, and 13, vol. 66; also SUPPLEMENT, Nos. 792, 902, 831, 692, 847, 825. 3. What is the highest number alternations in a magneto-dynamo, such as is used for shocking purposes? A. From a few hundred up to two thousand or more a minute. There is no "highest number." 4. Suppose an electric battery be made by making a lead tray 6 × 6 and 4 inches deep. In the bottom is put sulphate of copper 1 inch deep, and over that 1 inch sawdust. A zinc plate on the sawdust as positive pole; binding screw on tray and one on zinc. Solution used, water. What voltage and amperage would it give? Would it give continuous current? How long would such a battery last (if used every day of twenty-four hours) before becoming exhausted? A. About one volt. The continuous current will be, perhaps, half an ampere. Its period of running would depend on the resistance of the outer circuit. 5. Will a bichromate battery, with porous cup filled with bichromate potash and outside vessel filled with a solution of common salt, continue in action for a greater number of hours than the ordinary one solution bichromate battery? A. It might run longer, but would give a far less total of electric energy.

(5621) A. H. writes: 1. One of my zincs of a Daniell gravity cell has been almost destroyed, while the other two are not affected in the least. There has been no solution in the jars for about one month, and during this time the zincs were covered with a copper-like substance, which had formed while the battery was in action. How was it that one zinc was destroyed and the other two were not affected? A. It seems probable that the destroyed zinc was more attacked than the others before you laid up the battery. Corrosion would be slow, if the zinc was not in the solution. 3. How much wire on the field magnets of the hand power dynamo, No. 161, and also how many feet on the armature, as near as you can judge? A. Five pounds wire for magnets, 100 feet for armature; if drum wound, about 200 feet. 3. Do not the brushes have to touch one commutator segment before it leaves the other? A. No. 4. Can a Porter's motor, No. 1, be used as a dynamo? A. You will not get much result, we think. We have no figures as to its voltage and amperage.

(5622) N. T. asks: Of the various kinds of batteries, such as storage cell and plunge, which is the strongest? A. Storage batteries are far the strongest. How to make them is told in SUPPLEMENT, No. 845. Other batteries, 157, 158, 159, and 792. Also see storage batteries in SUPPLEMENT, No. 838. These we can supply for 10 cents each.

(5623) E. A. E. writes: I would like to build an induction coil that will produce a 4 or 5 inch spark. Can I follow directions as given in SUPPLEMENT, No. 160, and are there any changes I can make that will be a benefit to it? What is the object of the insulation of resin and wax between the two sections of the secondary coil? Also, have you any books or papers from which I can get information on this subject? A. You will find it quite difficult to make a successful 5 inch spark induction coil. The object of the disk is to separate portions of the secondary which differ greatly in relative potential. For a large coil, 6 or 8 such disks should be used. For other coils, see our SUPPLEMENT, Nos. 229 and 569, and SCIENTIFIC AMERICAN, No. 14, vol. 66, all of which we can supply for 30 cents. Also, "Induction Coils—How Made and How Used," price 50 cents; also Bonney's "Induction Coils," price $1 mailed.

INDEX OF INVENTIONS

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December 12, 1893,

AND EACH BEARING THAT DATE.

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